THE

JOURNAL

of Conventional Weapons Destruction

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20th edition!

BEST PRACTICES IN CWD

In the Spotlight: EASTERN EUROPE & THE CAUCASUS

IN EVERY ISSUE: FIELD NOTES | RESEARCH AND DEVELOPMENT

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The Journal Editorial Board reviews all articles for content and readability, and it reserves the right to edit accepted articles for readability and space, and reject articles at will.

Authors who submit articles to *The Journal* are expected to do so in good faith and are solely responsible for the content therein, including the accuracy of all information and correct attribution for quotations and citations.

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ON THE COVER:
As part of a request from the United Nations Mine Action Service (UNMAS), MAG worked with the Malian Defence Security Forces (MDSF) from October 2014 to destroy more than 10,000 weapons.
Photo courtesy of Sean Sutton, MAG.

FEATURE

BEST PRACTICES IN CWD

SPOTLIGHT

EASTERN EUROPE & THE CAUCASUS

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FROM THE DIRECTOR

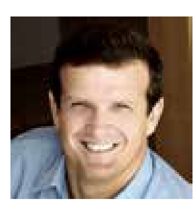
Welcome to our 20th edition of *The Journal*! This is an exciting year for us as we celebrate the twentieth anniversary of the Center for International Stabilization and Recovery (CISR) as well as *The Journal*. Since our founding in 1996, CISR's mission, programs and publications have continuously evolved with the ever-changing face of mine action, reflecting the training, informational and program needs of the field. As mine action is absorbed into the broader scope of conventional weapons destruction, CISR and *The Journal* are prepared to be the information leader for this community of practice. With great anticipation we begin this edition of *The Journal* with a new design and title—*The Journal of Conventional Weapons Destruction*.

We begin our twentieth edition with an editorial from Russell Gasser, in which he questions the benefits of large-scale spending on research into new technologies, especially when funding to develop and share solutions based on existing technology is sparse. We encourage readers to share their thoughts with us.

In our Feature section we look at best practices in conventional weapons destruction. Marlene Dupouy and Charles Frisby (UNMAS) review UNMAS's stockpile destruction of obsolete surface-to-air missiles program in Mali, and Mark Frankish (UNMAS) reports on the UNMAS Gaza Emergency Response in 2014. Chad Clifton (Sterling International Group, LLC) discusses the use of thermal treatment to destroy large caliber ammunition in Bosnia and Herzegovina, while Chris Loughran and Djadranka Gillesen (MAG, Mines Advisory Group) take stock of MAG's armed management and destruction programming, based on lessons learned over the past two years.

Our Spotlight is on Eastern Europe and Caucuses, specifically disaster response planning. Abigail Jones and Edward Crowther (Danish Demining Group/Danish Refugee Council) discuss the provision of emergency risk education to internally displaced persons and returnees in Ukraine, and Dr. Darvin Lisica and Dr. Stuart Maslen (Norwegian People's Aid) discuss the continued need for clearance work in Kosovo. Finally, Faiz Paktian from GICHD reviews the organization's Eastern Europe, Caucasus, and Central Asia Outreach Programme.

As we reflect on *The Journal's* evolution through these past twenty years, we would like to take this opportunity to extend our gratitude to our contributing authors, peer reviewers, and of course, our readers around the globe. We would not be where we are today without you. Thank you for contributing, for reviewing and for reading *The Journal* throughout the years. As you may note, this edition features articles represented by a number of industry experts and international organizations working in the field. Programs are reviewed, successes are discussed along with failures, and current practices are brought into question. This is the role of *The Journal*; to act as a medium through which to explore differing viewpoints, as well as an information source and sounding board for the field of mine action and conventional weapons destruction. As we move into our twentieth year, I encourage you to reach out to us with topics you would like to see covered in future issues. *The Journal* is an information source for us all, both in print and online, and we encourage our authors and readers to continue utilizing this great resource available to our community of practice. Visit us online at www.jmu.edu/cisr



Ken Rutherford
CISR Director

Photo courtesy of Missouri State University Photo Services

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20 CISR

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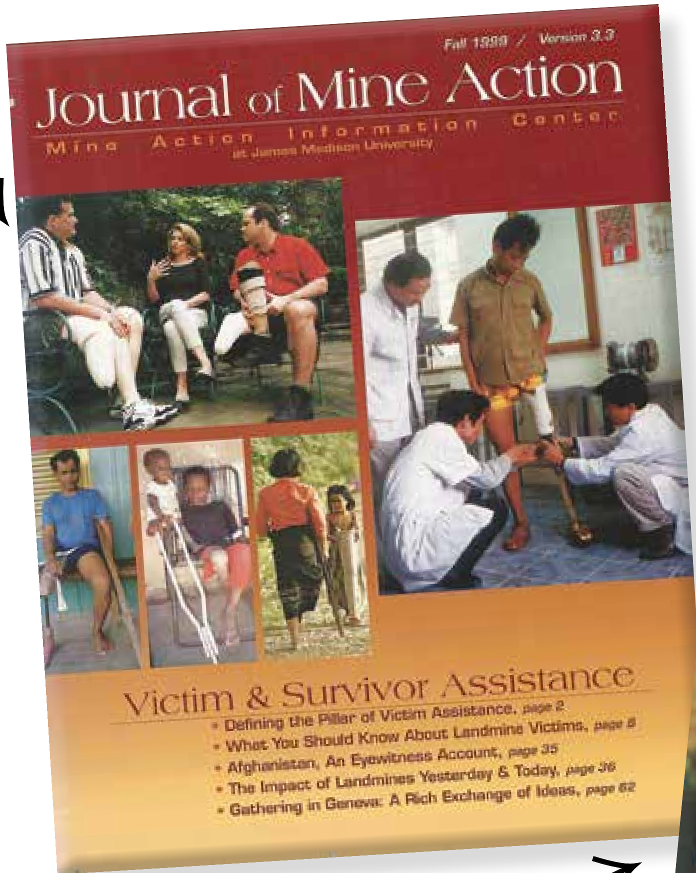
1999 – The first printed edition – with Ken Rutherford on the cover!



2008 – The name changed to The Journal of ERW and Mine Action

» (Above left) The cover of our very first printed edition of *The Journal* in Fall 1999 after three volumes of online-only publication. CISR Director, Ken Rutherford is in the upper left hand corner with Queen Noor of Jordan and Jerry White, co-founder of Landmine Survivor's Network (Survivor Corps).

» (Above right) *The Journal* changed its name from *The Journal of Mine Action* to *The Journal of ERW and Mine Action* with Issue 12.2 in Winter 2008-09.

» (Right) Commemorative coins were produced in 2001 to celebrate our relationship with James Madison University. In 2008, the Mine Action Information Center was renamed The Center for International Stabilization and Recovery.

Since 2010
Issue 14.1
April 2010

→ more than **310** articles published

→ more than **230** contributing authors

→ more than **110** contributing organizations

Technology Research in Mine Action: Enough is Enough

by Russell Gasser

Twenty years ago I started work on a doctorate thesis asking the question: “Why has research into new technologies for mine action had so little success?”[1] My research discovered that about one billion dollars had been spent by the year 2000 on fundamental and applied research to produce new technologies to solve the mine problem.[1] The resulting benefit for humanitarian mine action was indeed very small. Since then, large-scale spending has continued with limited success. Researchers and their funders have not learned from continued, expensive failure. There is clear cause and effect at work, which means that many research projects and programs have followed a similar route to failure.

New technology has an important role in making mine action faster, safer, cheaper, or some useful combination of these three. Major gains to safety and/or productivity have resulted from the use of satellite and cell phones, GPS, digital cameras, laptops and tablet computers, map plotters, Google Earth mapping, polycarbonate for visors and Kevlar for protective vests and much more. However, none of these gains came from research into new technologies for mine action, they all came from adapting and applying useful, off-the-shelf products. These products could afford the high cost of research and development as they had a large-scale market.

Mutual misunderstanding between researchers and demining organizations began in the early 1990s when research into mine action technology started receiving large amounts of funding. Field practitioners in humanitarian demining wanted better tools and equipment as soon as possible and at affordable prices. Researchers offered to help but didn’t manage to communicate that academic and industrial research is expensive and usually several years away from yielding finished products. Too many researchers did not understand why deminers were so reluctant to test unproven equipment in live minefields. Too often both sides felt let down by each other.

What researchers produce is usually several steps away from being usable in the field. Research results need to be turned into realistic prototypes that can be tested, which is the first step. Prototype tests then lead to a production design, and finally a production version that is first tested in simulation and then certified in live areas. However, this does not automatically mean the technology is going to be cost-effective or worth using, and each one of these development steps can cost more than the original research.

Researchers and their funders were highly motivated by what they saw as a moral obligation to focus their efforts on this humanitarian task. There was apparently a widespread assumption that there was no available means of clearing mines and that any advance—no matter how complex or costly—would be a step forward. In fact, manual demining methods were already well developed by the late 1980s. When properly managed, manual clearance was safe and reasonably cost-effective. My investigations showed that as much as 80 percent of the demining research aimed to improve the detection of buried mines, usually minimum metal mines, and ignored the majority of other urgent problems that field managers face. In the 1990s, a minority of researchers began to analyze the problem. The Development Technology Unit of the University of Warwick in the United Kingdom, where I was working, observed deminers in Cambodia from a safe distance. We discovered that they spent up to 70 percent of

Photo courtesy of CISR.

their time cutting vegetation. Clearly, the vegetation clearance problem was urgent and led to the Tempest mini-flail, locally produced in Phnom Penh.[2]

In terms of reducing the cost and time of returning land to productive use, area reduction (defining the boundaries of the area that has to be cleared) and the resulting release of land without clearance is probably the single most important issue. Although the topic was mentioned at conferences, only a few mine action field practitioners flagged this as an issue and researchers did not pick up the topic.[3]

Expensive research projects continued to produce marginal gains in mine detection by developing equipment suitable for use on flat ground without vegetation. In terms of pure research, this is the obvious path: start with the theory, develop the techniques, and gradually apply them to real world scenarios by developing prototypes to test. But this was not what the mine action world wanted. In 2016, as many countries approach the end of proactive mine clearance and are moving to management of residual contamination (MRC), the need for long-term research is becoming even harder to justify.

In the 1990s, there was a tango that went around and around but led nowhere. At meetings, researchers would ask "What are the key problems that we should be working on?" and field staff would reply, "What are the main areas where you can make a difference?" I remember one well-intentioned project where the researchers gave the mine action staff a long list of issues that the research could address and asked for prioritization. The response was that all the problems were "very important." Thus, no progress was made as no priorities were identified. Priorities cannot be determined by emotional appeal but instead need analysis and tough decisions. Even less common were cost-benefit analyses.

At times, the degree of separation between the research lab and the field led to multiple failures. One research project co-funded by the European Commission discovered that their lab equipment overheated and failed during field trials in Africa. Did their field partner not inform them about the hot weather because it seemed too obvious? Without a prior survey, the manufacturer of a large, mine clearance machine complained that Cambodia had the "wrong type of minefields" despite spending large amounts of donor money to have the machine transported.

Six Primary Reasons Why Mine Action Technology Research Has Yielded Few Results

1. There is a deep-seated psychological need to address the horror of stepping on an unseen, anti-personnel (AP) mine as the top priority. There is also the feeling of "just one more breakthrough and we will be there." Both of these tend to overrule rational analysis. This is not a research issue; fundraising also relies on the public response to the horror of AP mines. Unexploded ordnance kills and injures more people than AP mines, and unplanned explosions of munition stockpiles kill even more. However, the research proposals that seek to improve AP mine detection often focus on relatively uncommon minimum metal mines.

2. While researchers wanted to improve knowledge and its application, field practitioners usually thought the purpose of donor funding was to provide better tools and equipment in the short to medium term. Too much research focused on generating solutions to problems that were not clearly identified. In one case, a project that cost several million Euros of public money showed that the probability of detecting mines was reduced when the project's "data fusion" method was applied. In the project's final evaluation, a university professor declared that the project was a useful contribution in that it showed what did not work, which was true but did not immediately benefit deminers.

Whereas many researchers and donors want to focus on breakthrough technologies, demining needs incremental improvements to well-established methods and technologies. Dismissing incremental improvements because they are somehow less important is a serious error. Metal detectors are an example of a successful, incremental improvement; performance now is far better than it was 20 years ago; sensitivity, background compensation, size, weight and battery life have all significantly improved by manufacturers. Advanced and automatic data fusion methods for multi-sensor detection received millions of research money to seek a breakthrough but made little or no impact in the field.

3. There has been a widespread failure to understand the economics of humanitarian demining. There are two parts to this misunderstanding: the first involves the overall economic purpose of mine action whereas the second concerns the cost of going from lab research to a finished, usable product.

There may be no overall benefit from a modest reduction in clearance costs if the money is diverted away from the local economy in the mine-affected country and instead supports high-tech research in first-world countries. The purpose of mine action is to save lives, reduce injuries and help reestablish livelihoods postwar. Employing hundreds, or even thousands, of deminers is an effective way to stimulate the local economy. The effect multiplies and boosts recovery

"Metal detectors are an example of a successful, incremental improvement..."

efforts as money recirculates around the community, and local people start small businesses. If the objective of mine action is to rebuild war-torn economies and help local people, diverting resources to a rich country to pay for advanced technology in order to get a small gain on price per square meter makes no sense at all. Achieving the overall purpose of mine action is what matters; cost per square meter is only one part of this. Some new technology proposals have even threatened to drive up the cost of clearance. One such project received millions of Euros of public money and was based on detecting explosive using neutrons. The neutron generator required was very expensive, had a short life span and was so powerful it required registration by the user to comply with the Nuclear Non-Proliferation Treaty in force at the time.

The second economic issue is the gap caused by the amount of time and money that successful laboratory research needs to yield a certified product for the field. Transition is difficult, slow and expensive, and usually costs more than the original research.

The market for improved mine action technologies is small and insufficient for expensive commercial development. While I was project officer for new technologies at the European Commission in the early 2000s, many research funding proposals overestimated the potential sales of a future product and underestimated the cost of product development. A few projects predicted that the annual sales of their product would be worth more than the best estimate we had for the global budget for all humanitarian demining equipment worldwide.

4. Risk management has unexpected side effects. Most donors are not specialists and know little about mine action technology. To manage risk, they seek subject experts, who can make decisions on which projects to fund and how to evaluate progress. For some public sector donors, the use of these independent experts is a requirement. Available experts 20 years ago were usually academics with deep knowledge of the technology proposed or one of a group of recognized international mine action consultants who often had limited experience with military demining. It was difficult to recruit active field staff who comprehensively understood humanitarian mine action at the ground level; evaluating research proposals was widely viewed as a complete waste of time for field staff. The situation was exacerbated by the requirement of some agencies for consultants to have advanced university degrees. Non-specialist donors had no understanding of the enormous gap between the pool of available subject experts to decide on research proposals and the field practitioners who wanted better tools and equipment for immediate use in far-off lands.

Another effect of the dominance of military demining experience 20 years ago was large-scale funding for research projects focused on well-established military demining tasks. Some of these had little or no application to humanitarian demining. There was no intention that humanitarian funding should be used for military research, but at times that is what happened for some high-cost technologies later used for military purposes but not for humanitarian demining.

5. A number of high-profile research projects, often supported by internationally well-known people, have gained public support and leveraged large-scale funding. The projects proposed were often expensive and unfeasible (e.g., reliable, airborne detection of individual buried mines through vegetation; rolling heavy objects over uneven terrain in a random way without recording exactly where they passed), or were so expensive as to be entirely impractical for humanitarian purposes even if the technology worked. The publicity only mentioned the potential benefits, not the costs: "we have a responsibility to get these mines out of the ground and make the land safe for people to live a normal life without fear."[4] These projects not only wasted money but created a false public perception of demining and the role of mine action technology, and marginalized the demining organizations that they claimed to help. Moreover, they ignore the current solution: the properly trained and equipped human deminer.

6. Mine action practitioners have not always shown interest in the best research ideas and, at times have indiscriminately treated all research as equally lacking in value. For example, in 1999, a student research team discovered that oval, cross-section prodders (a cheap and simple tool) significantly reduced the force needed to prod into hard soil compared to normal, round-section prodders. Accidentally detonating mines while prodding in hard soil is a known source of accidents, so this simple, research-based advancement in technology could be expected to be widely used and well-publicized in the mine action community. The risk to deminers could be reduced by specifying oval prodders in operating procedures, contracts and mine action standards. However, the idea has not been widely embraced or shared. Is this the result of a "not invented here" attitude, or just poor communication of ideas?

Conclusion

As mine action in many countries moves from proactive clearance to reactive MRC, there is a real opportunity to improve the take-up and cost effectiveness of new technology. MRC is a well understood process with a long history of success, especially in northern Europe. There is already a wide range of commercial equipment, from simple hand tools to hi-tech systems, that is in daily use in countries still clearing explosive remnants from the two World Wars. There is no significant technology gap that prevents effective MRC from working in Europe.

Adapting existing techniques and solutions for use in new climates and areas without the supporting infrastructure found in Europe will naturally require some resources. However, we cannot possibly justify repetitive research and development in an effort to reinvent the wheel.

For proactive clearance, there are a lot of adaptive and ingenious solutions that have already been developed under field conditions or through appropriate research such as the oval-section prodders mentioned above, or the use of rakes. Many of these solutions are known only locally because they have not been published or shared. Busy field staff rarely have spare time, extra money or interest in the amount of work required to publish an article or attend a conference. An equipment catalogue that is more than a manufacturer's sales sheet is needed. Collecting and sharing information about inventive solutions to regional problems (as well as broader problems) is both urgently needed and far more cost and time effective than high-technology research. An online catalogue that includes photos, videos, interviews and information about actual results, including costs and benefits, would be a valuable resource. Translation is an essential requirement for accessibility, while constant maintenance and updating is necessary.

After the information is collected, it should be made available to people who can use it. This goes far beyond providing a website or a printed document, even beyond more accessible technology such as apps for smartphones and tablets. Sharing information must be an active process to identify, contact, interest and earn the trust of people who could benefit from the information. This is perhaps where research is needed. How do we get field managers, especially national staff, to take an interest in and put aside time to learn about technologies that could benefit their programs? The Croatian Mine Action Centre (CROMAC), United Nations Mine Action Service (UNMAS) and the Geneva International Centre for Humanitarian Demining (GICHD) organize mine action technology conferences, but at the last UNMAS/GICHD conference, out of more than 70 participants, fewer than 10 were national staff from mine affected countries. How can we encourage more people who will select the technologies needed for their country and approve equipment budgets to attend? Why is this not already a priority?

Mine action could learn from other areas where a community of practice has been established to support this type of technology transfer. Building a community of practice is not an easy task but would ensure that mine action technology moves forward in terms of cost effectiveness and deminer safety.

In addition, donors who are interested in funding mine action technology research would benefit from learning about the realities of technical needs, the low probability of getting past the research stage to a production prototype, and the need for cost-benefit and technical appraisal.

Perhaps the most important question to ask is why millions of dollars is available for research into technology that is unlikely to succeed whereas funding to develop and share solutions based on existing technology is sparse. This is the core question that needs to be answered if we are to learn from experience.

It's time to end the current situation where huge expenditures have achieved so little, and technology research continues to deliver poor value for money.

See endnotes page 66

The author wishes to thank Bob Keeley for his comments on the draft.

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European Commission in Brussels, an independent evaluation consultant for eight years, and until recently was on the staff of the Geneva International Centre for Humanitarian Demining. His current focus is on results-based management, theories of change, and evidence based evaluation, as well as technology for mine action.

STOCKPILE DESTRUCTION OF OBSOLETE SURFACE-TO-AIR MISSILES IN MALI

by Marlène Dupouy and Charles Frisby [United Nations Mine Action Service]

Inadequate management of ammunition stockpiles can cause accidental explosions. The Small Arms Survey lists a total of 528 unplanned explosions of ammunition storage sites since January 1979, in more than half of United Nations member states.[1] The March 2012 incident, which took place in Brazzaville, Republic of the Congo, is a reminder of the danger posed by poor stockpile management, as well as the tragic consequences affecting the population, environment and governments as a result of financial costs of clean-up exercises. The explosions in Brazzaville killed at least 300 people, injured more than 2,500 and left over 121,000 homeless, according to Small Arms Survey.[2]

In Mali, the United Nations Mine Action Service (UNMAS) operates under the mandate of the United Nations Multidimensional Integrated Stabilization Mission (MINUSMA) to help the government ensure the safe and effective management, storage and security of national stockpiles.

Responding to a request from the Malian Ministry of Defence to reduce the immediate risks posed by unsafe missiles, stored near the Bamako-Sénou International Airport (Mali's capital city), UNMAS disposed of 85 obsolete and expired surface-to-air missiles. The demolitions began on 28 March 2014 in the Koulikoro region, 80 km (50 mi) north of Bamako, and were successfully completed on 6 June 2014. Surface-to-air missiles are not commonly encountered and require specific skills and methodologies for disposal.

An obsolete surface-to-air missile covered with dust in Bamako before being moved to the demolition site.
All photos courtesy of Marc Vaillant, UNMAS Mali.

Identification of a Threat

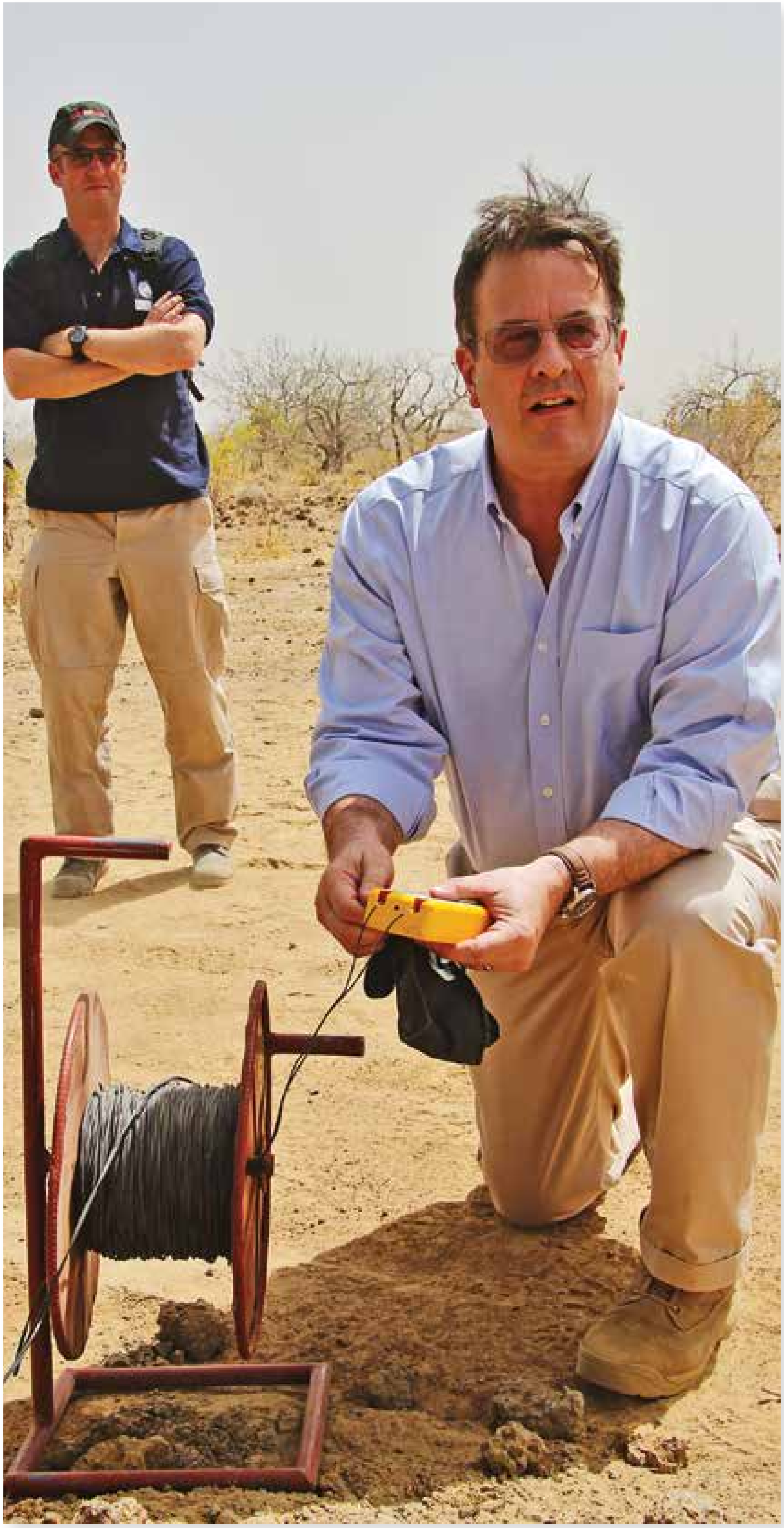
Over the course of UNMAS' assessments of ammunition-storage facilities throughout Mali, a number of stockpiles of unserviceable, obsolete and unsafe ammunition were found and recorded—these included 85 surface-to-air missiles located in an urban area. The shelf life of the missiles—which were delivered to Mali from the Soviet Union in the late 1970s—expired in 1988, leaving the missiles unserviceable. Unless destroyed, the propellant within the missiles would have degraded over time to the point of an apparent spontaneous combustion. Gradual degradation of explosive or hazardous components in outdated ammunition poses a serious explosive hazard and is a primary cause of unplanned explosions of ammunition stockpiles.

The Demolition Process

Starting on 28 March 2014, all operations were closely coordinated with the Malian Defence and Security Forces (MDSF), which contributed to building a relationship of trust between UNMAS and the Malian authorities. Following a technical assessment of the physical

All missiles were moved to the demolition site progressively, with an average of two missiles moved and destroyed every day over two months.

UNMAS team securing and dismantling a missile in preparation of destruction.



David Gressly, Deputy Special Representative of the U.N. Secretary General/ Humanitarian and Resident Coordinator, activates the demolition of two missiles during his visit to the demolition site on 18 April 2015, with the assistance of UNMAS Programme Manager, Charles Frisby.

condition of the missiles, the team decided to move them carefully by truck from their location in Bamako to an isolated demolition site in Koulikoro, which UNMAS previously prepared.

Six members of MDSF, who previously underwent Explosive Ordnance Disposal (EOD) training, were deployed to the demolition site for on-the-job training where they gained practical skills and firsthand experience as they participated in the disposal process. Following preliminary preparation of the missiles, they were disposed of through a controlled burn of the rocket motor and propellant, coupled with detonation of the high explosive components.

Professionally implemented in accordance with International Mine Action Standards (IMAS) and the International Ammunition Technical Guidelines (IATG), the operation went smoothly and safely. A ceremony attended by representatives from MDSF, the United Nations and national and international journalists marked the completion of the project on 6 June 2014.

Stockpile Management Impact

Disposal of obsolete ammunition stockpiles helps to minimize the risk of accidental explosions, therefore protecting civilians from potential threat and displacement, while also preventing the destruction of infrastructure and reducing related economic impact. Stockpile management is more than the prevention of unplanned or accidental explosions—it is also a matter of preventing unregulated access to weaponry. As such, the project also contributes to the U.N.'s regional and international disarmament and counter proliferation efforts.

This project is part of UNMAS' efforts to support the Malian authorities

Deputy Special Representative of the U.N. Secretary General/ Humanitarian and Resident Coordinator, David Gressly, during his field visit on 18 April 2014, with UNMAS Programme Manager Charles Frisby.

to secure and safely manage national weapons and ammunition stockpiles, which includes the refurbishment of armories and the provision of technical support and training to the MDSF. Training and capacity-building activities are essential to ensure the sustainability of such projects. Knowledge and competencies must be developed at various levels, ranging from the institutions responsible for security to the personnel in charge of managing weapons and ammunition depots. UNMAS Mali provided training courses in storage safety and management to 57 MDSF personnel (depot manager, armorer and administrator levels) during 2013 and 2014. In addition, 50 MDSF personnel from Gao and Bamako received a practical two-day introduction to stockpile safety and management. UNMAS regularly shares key lessons learned with the headquarters team and the peacekeeping mission.

Planning for the Future

National authorities expressed appreciation for the safe destruction of the missiles, after which the Ministry of Defence made a new request for the destruction of an additional 60 tons of obsolete ammunition stored in the wider area of Bamako, (mostly artillery projectiles, mortars, rockets and grenades). The latter was completed in late June 2014.

The UNMAS program has destroyed a total of 390 tons of weapons and ammunition in Mali, with operations ongoing. This first disposal of 85 missiles laid the foundations for years of partnership with the government of Mali to reinforce its ability to manage explosive threats throughout the country.

See endnotes page ##

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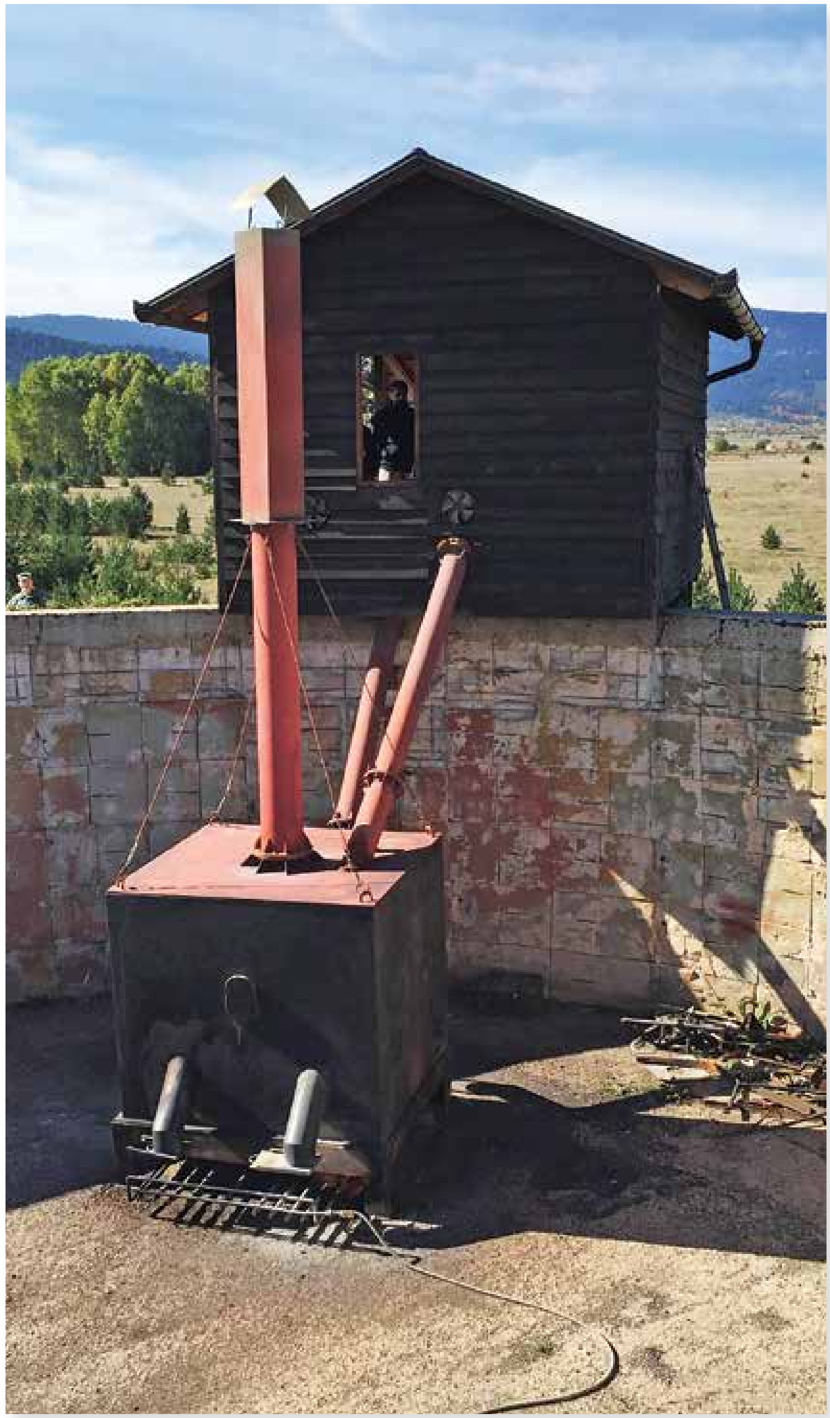
THE ARGUMENT FOR THERMAL TREATMENT: BOSNIA AND HERZEGOVINA

by Chad Clifton [Sterling International Group, LLC]

Historically, large, aging conventional weapons stockpiles in Bosnia and Herzegovina have been a challenge to regional security in Eastern Europe and potentially beyond. The International Trust Fund Enhancing Human Security (ITF), the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), and many other donors have funded stockpile reduction efforts in Bosnia and Herzegovina and in surrounding regions since 1999. Currently, PM/WRA funds U.S.-based contractor Sterling International Group, LLC (Sterling) to destroy weapons stockpiles under a bilateral technical agreement between the United States and the government of Bosnia and Herzegovina. Under this agreement, Sterling destroys approximately 500 tons of excess munitions yearly through open burning and open detonation at the military range facilities near Glamoč. This program is a continuation of an effort originally funded by PM/WRA in 2009 and implemented through ITF.

The destruction of these munitions occurs near the end of a long chain of activities conducted by the Armed Forces of Bosnia and Herzegovina to demilitarize or otherwise disassemble explosive items. Munitions that cannot be disassembled due to age, condition or other technical issues are sent to Sterling at Glamoč. A high priority for the governments of the United States and Bosnia and Herzegovina has been the destruction of 20 mm ammunition due



Thermal treatment furnace at Glamoč as seen from a protective concave wall.
All photos courtesy of Sterling International Group, LLC.

to the age and condition of these stockpiles. This ammunition type, high-explosive incendiary (HEI) and HEI with tracers (HEI-T), was the cause of a major explosion at a facility performing manual large-scale disassembly in nearby Serbia. The Armed Forces of Bosnia and Herzegovina determined that it would take a disproportionate amount of time and resources to disassemble these munitions and then dispose of the primers, powder, warheads, tracers and cartridge cases. These munitions were therefore marked for destruction by open burning and open detonation.

Challenges With Destruction

Ammunition of this type presents a unique problem: it is too thick for traditional explosive destruction. The thickness of a 20 mm projectile casing and the relatively small explosive weight of each round make it expensive to destroy using military-grade explosives, such as C4 or Semtex, and nearly impossible to destroy using most commercially available explosives. For example, estimates indicate that 1 kg (2.2 lb) of plastic explosives would be required to detonate eight 20 mm rounds if conducting open detonation, which is a large consumption rate considering the cost of military-grade plastic explosives. At approximately US$17 per kilogram, they are difficult to procure and troublesome to transport. Destroying the 2 million 20mm rounds classified by Bosnia and Herzegovina for destruction would cost approximately $4.25 million in explosives alone—not including the cost of technicians, support staff and other project requirements.

The range at Glamoč allows a very small net explosive quantity of only 300 kg (660 lb), which allows approximately 1,200 20 mm rounds per shot and is very expensive in terms of personnel and time.

While too tough for efficient explosive destruction, 20 mm is often considered a bit too large for thermal treatment. Many programs conduct open burning of small arms ammunition where munitions are unpacked and loosely spread in an open pit containing wood or other flammables. The pit is then doused with fuel and ignited. The resulting flames ignite the propellant in each round, which launches the bullet a short distance and is generally contained within the pit. Steel furnaces replaced this type of open burning in which the combustible material and small arms munitions are placed within a large steel box, and the burn is conducted in a manner similar to the pit. However, unlike the pit, the furnace is safer and contains the small explosions from the propellant, trapping bullets as they fire. Many ammunition technicians refer to this arrangement as the popcorn treatment. Furnaces can also be outfitted with filters and ventilators to control the release of particulates into the atmosphere. Some furnace designs include a steel feed tube or chute, which allows operators to slowly add more ammunition into the furnace and maintain the heat level, thus maximizing the heat and effectiveness of the operation.

Sterling workers demonstrate destruction of 20 mm ammunition to U.S. and Bosnia and Herzegovina government observers.

Earth, concrete and steel containers form a concave barrier away from personnel in the chute structure.

Unfortunately, unlike conventional small arms ammunition, which contain a solid lead or metal alloy projectile, 20 mm cartridges contain a fuze and internal explosive material designed to detonate upon hitting the target. This type of explosion is much larger than the pop of the propellant and generally exceeds the safety limits of most locally constructed steel-box furnaces. Although a number of commercially manufactured furnaces could deal with 20 mm, these are expensive to build and operate, often approaching the cost of explosive treatment previously described.

This created a logistical and technical problem for the Armed Forces of Bosnia and Herzegovina as they addressed millions of unwanted 20 mm rounds in their inventory. Sterling responded by expanding upon existing designs for thermal treatment of ammunition and developed a 2-x-2-m (2.2-x-2.2-yd) furnace with inserts.

Solution to Large Caliber Munition Destruction

Made of 20 mm rolled steel, the Sterling furnace can safely contain the explosive force of 20 mm detonations. Likewise, Sterling increased the thickness of feed chutes, vents and chimneys to 10–15 mm to deal with increased heat and explosive force. Rather than use dunnage or other combustible material inside the furnace, it is heated from the outside using large, remotely controlled propane or oil-fired burners.

Once the furnace reaches a temperature of 250 C (482 F), operators feed a small amount of ammunition into the furnace core via a baffled feed chute. Operators are approximately 35 feet from the furnace while detonations occur. There is adequate steel and concrete between the operators and the ammunition. The furnace is designed to contain all of the hazardous effects from the blast. The chute contains a two-door system, which lets the operator load several rounds into the feed chamber, close the safety door and then open the release door, allowing new munitions to slide into the combustion chamber. The chute's height and angle is configured to allow operators to work at a safe distance from the low-level explosions occurring within the furnace. Operators feed ammunition at a steady rate while constantly monitoring the sounds of each explosion, thereby preventing a buildup of ammunition that might exceed the furnace's design.

The furnace routinely runs at its operational temperature for up to five hours, disposing 3,000 rounds of 20 mm ammunition per day. Smaller caliber ammunition, such as 12.7 mm, can be disposed at a rate of 10,500 rounds in a typical workday. This furnace configuration burns through approximately 35 L (9 gal) of propane gas per hour, varying slightly in relation to outside temperatures.

Sterling made a number of improvements to the furnace based on its experience with this method. The blast chamber was modified to incorporate removable inserts, allowing larger caliber ammunition such as 20 mm cartridges to detonate inside the furnace without damaging its interior. While the nature of the replacement process means the furnace will still need to cool down before damaged inserts can be replaced, the operation maintains spares to eliminate any additional

Personnel load items into the furnace via one of two chutes. Gas burners below furnace raise internal temperature above 250 degrees Celsius (482 degrees Farenheit).

downtime while damaged inserts are repaired at an off-site facility without halting operations. The cost of insert repairs is also lower than repairs to the furnace interior. The inserts also baffle the blast, reduce noise pollution and contain the blast fragments.

Since incorporating the thermal treatment furnace into operations in late 2013, Sterling destroyed more than 300,000 rounds of 20 mm ammunition along with more than 1.5 million rounds of other small arms ammunition. At this pace, more than 2 million unwanted 20 mm rounds in Bosnia and Herzegovina will be eliminated within two years at a fraction of the cost needed to dispose of these rounds by other means.

Drawbacks of Thermal Treatment

Although cost-effective, thermal treatment has its downsides. Even with a number of safety features, the design still incorporates operators working in fairly close proximity to the furnace, which could prove dangerous if an uncontrolled detonation were to occur. Therefore, strict control is required when feeding the munitions into the chute and in monitoring individual detonations. Moreover, furnaces remain hot for several hours after combustible material is introduced by design, preventing quick stoppage following a perceived incident. The furnace must cool down while operators remain at a safe distance. In 2014, operators overwhelmed the furnace, building up explosive material that ignited and damaged the furnace.

Emissions are also a concern during these operations. Particulates released from the chimney are constantly monitored, verifying that emissions meet environmental standards in Bosnia and Herzegovina. Environmental controls inherent in the design include but are not limited to the following: containment of hazardous materials, high burning temperatures that ensure complete burning of materials, a relatively tall chimney, and good air flow design. To protect the surrounding environment, nearby soil and water are closely monitored for possible contaminants. Operators on-site are required to wear respirators and protective clothing to shield against lead

Removable inserts isolate 20 mm ammunition and allow separate repairs and uninterrupted operations.

exposure. Operators are also physically examined to ensure they are not exposed to dangerous contaminants. These precautions also occur at demilitarization (DEMIL) facilities that disassemble or pull apart munitions.

Furnace designs may need alterations in some countries, as environmental regulations might require chimney scrubbers and other means of attaining emission levels consistent with national standards. Companies pursuing a thermal treatment operation must examine the standards of the country in question.

Conclusion

Conventional weapons and ammunition stockpiles jeopardize safety and security in a large number of countries. Given the global economic climate and location of conventional weapons destruction problems in many developing countries, an efficient, effective and reasonably priced solution is critically important. A thermal treatment furnace following a fairly low-technology design can be produced within local economies for under $50,000. This method can destroy ammunition stockpiles quickly and safely, especially 20 mm ammunition, without the need for expensive explosive material. The process requires fewer personnel, and the training requirement for operators is much lower than required for DEMIL or open burning and open detonation. Fuel costs are also low through use of locally available fuel oil or other standard heating fuel. Fuel costs average $0.02 per round. This figure is based on 35 L of fuel (at current exchange rate) to treat 3,000 rounds of 20 mm ammunition. The furnace is ultimately a safe option as well, with blasts contained and shrapnel potential eliminated. The furnace is certified using U.S. Department of Defense best practice methodology during research and development work (1.25 times the limit) and the shielding was tested well beyond this threshold. Thermal treatment is an excellent option for African, Eastern European and Southeast Asian countries with stockpile-reduction requirements. It is an appropriate solution that is effective, efficient, productive and safe.

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UNMAS GAZA EMERGENCY RESPONSE REPORT

by Mark Frankish [UNMAS Gaza]

Extent of ERW damage in the residential area in Beit Lahiya, Gaza.
All graphics courtesy of UNMAS.

From 7 July to 26 August 2014, significant quantities of explosive ordnance were used during hostilities between the Israel Defense Forces (IDF) and Gazan armed groups. It is reported that approximately 72,000 items of ordnance were fired and launched during this period.[1] This presented a significant risk for civilians and hampered humanitarian and reconstruction operations. Many unexploded aircraft bombs, tank projectiles, mortar shells and other munitions from both sides of the conflict were reported in civilian areas. Based on a 10 percent fail rate, it was assumed there are approximately 7,200 items of explosive remnants of war (ERW) in Gaza, including a significant number of air delivered bombs.[2] The ERW contamination has interrupted the lives of entire communities in Gaza, where simply gaining access to homes, schools, health facilities, etc. is challenging and dangerous. Livelihoods are also directly affected when small industries and farmlands are destroyed and littered with ERW.

The military operations resulted in over 2,000 casualties in Gaza, 65 in Israel and massive damage to infrastructure and civilian property in Gaza.[3] A review on structures by United Nations Operational Satellite Applications Programme (UNOSAT) detailed that within the 327 sq km (126 sq mi) of the Gaza strip, 6,761 structures were destroyed, 3,565 were severely damaged and 4,938 were moderately damaged. In addition, there were 7,473 craters recorded in agricultural and non-urbanized areas.[4]

Approximately 74 percent of the damage sustained was within 3 km (1.8 mi) of the Armistice Line. Within this area multiple neighborhoods such as Shuja'iyya, Beit Hanoun, Khuza'a, etc., were damaged to such an extent that the vast majority of structures in these communities were completely destroyed.

Threat Defined

While the majority of ERW seen to date in Gaza is of conventional type, there have been no reports of submunitions or landmines used with the exception of anti-tank mines deployed by combat engineers in the destruction of buildings. Ground ordnance in the form of tank, artillery, cannon and

Damage Assessment Summary					
	Destroyed	Severely Damaged	Moderately Damaged	Total Structures Affected	Crater Impact
North Gaza	1,253	761	1,000	3,014	1,702
Gaza City	1,963	1,127	1,378	4,468	1,765
Deir Al Balah	809	406	683	1,898	553
Khan Younis	1,749	898	1,379	4,026	1,549
Rafah	987	373	498	1,858	1,604
Total	6,761	3,565	4,938	16,264	7,473

Figure 1. Damage assessment summary.

UNRWA classroom in Biet Hanoon.

Destroyed residential area of Shejaayea.

Removal of a neutralized 2000 lb bomb at the Rafah border crossing.

recoilless projectiles, mortar bombs, grenades, and rockets all exist. In addition, there is the threat from air delivered ordnance of up to 2,000 lb (907 kg) bombs and the toxicological hazard associated with fired-depleted uranium, armor-piercing projectiles.

UNMAS Gaza Emergency Response

On 27 July 2014, in response to a directive from the U.N. Secretary General, the United Nations Mine Action Service (UNMAS) deployed three explosive ordnance disposal (EOD) technical advisors to work directly with the United Nations Relief and Works Agency (UNRWA) and other U.N. agencies. The UNMAS team was based in the UNRWA compound during the conflict and was responsible for carrying out ERW risk assessments at U.N. facilities and other structures. This was to ensure that U.N. personnel and civilians seeking refuge in U.N. premises were safe from ERW and other explosive hazards. During the emergency response, UNMAS Gaza carried out 214 ERW risk assessments on facilities of which 209 were cleared and five were handed back to the parent organization to be included within the reconstruction phase. As a result, UNRWA was in a position to reopen all schools on their scheduled date, thereby enabling 240,000 children to resume their academic curriculum in a safe environment free from ERW. The UNMAS emergency response phase was critical to address immediate ERW and other explosive threats to the U.N., as well as responding to the critical humanitarian needs of the general civilian population.

This deployment was vital in facilitating an ERW response during the early stages of the conflict. The immediate ERW threats to the civilian population were addressed and requirements for a long-term ERW response were determined through a defined needs assessment. The assessment included the identification and analysis of the ERW threat, identifying those affected by the threat, as well as the extent and measurable effects caused by the threat. The approach was "bottom-up" whereby all community stakeholders and beneficiaries were consulted prior to any program development, thereby identifying potential barriers early. The results of the needs assessment were formalized within the UNMAS Gaza concept of operations (CONOPS).

Overview of ERW Risk Assessment

Generic risk assessment is a multi-disciplinary approach used by many organizations and industries for hazard identification, accident prevention and mitigation. It consists of an objective evaluation of hazards and risks in which suppositions and fears are measured, analyzed and presented so that a decision can be made concerning a course of action.

Within the context of the UNMAS Gaza emergency response, a hazard was defined as any item of ERW that could cause harm, whereas a risk was defined as the chance that somebody could be harmed by an ERW hazard. Therefore the ERW risk assessment was an invaluable process that determined how the ERW hazards were defined and how they affected planning and operations. A conscious decision was made to ensure that the processes should always work toward producing useful information that can be assimilated practically into all levels of operations. The ERW risk assessment was a systematic and investigative process that involved identifying hazards, predicting possible incidents, and determining the impact of hazards and mitigation measures that can be implemented or planned.

Principles of ERW Risk Assessment

The ERW risk assessments were conducted in a constantly changing environment due to the fluid nature of the conflict in Gaza. From an operational management perspective, the following core principles guided our principle-based approach:

- The protection of human life—conducting ERW risk assessments inevitably exposed individuals to a high level of risk; therefore, all exposure was preemptive and deliberate where possible, with all mitigation measures in place.
- The adoption of a holistic view—ensuring that the ERW risk assessments were viewed as an integrated system with several interconnecting components, all of which needed to be analyzed in order to determine the threat or hazard.
- The adoption of an investigative mindset—knowing the mission, method and means of the conflict often revealed the most probable type and extent of ERW contamination likely to be encountered. However, the importance of remaining open-minded was emphasized, as it can lessen the risks of making premature decisions and developing personal biases.
- The dissemination of detailed and practical findings ensured that mitigation measures could be effectively implemented and monitored with minimal disruption.

Phases of ERW Risk Assessment

In order to develop a comprehensive, reliable and consistent ERW risk assessment system, the following six-phased approach was adopted for all ERW risk assessment activities, regardless of requesting agency or facility type:

- Task planning
- Risk assessment
- Information analysis
- Report production
- Information dissemination
- Process evaluation

The phases flow in a continuous cycle creating a system that is self-improving and adaptable to most situations.

ERW Risk Assessment Methodology

Conducting ERW risk assessments within the context of the Gaza armed conflict, whether during the conflict or immediately after the cessation of hostilities, was challenging due to the specific facets that had to be considered. These facets included security, access, logistics, neutrality, and access to locations and information sources. Particularly challenging during the ERW risk assessments was the ever-changing security situation that could change from a workable, conducive environment to one of heightened danger in a short period of time. In an attempt to mitigate the security threat whilst conducting ERW risk assessments, a very specific security risk management plan through an ERW Security CONOPS was defined and implemented with the UNRWA field security office (FSO), which included:

- Casualty Evacuation procedures
- Contingency plans
- Coordination mechanisms
- Escort arrangements
- Identification of safe havens
- Route assessment and planning
- Security measures
- Security risk assessment matrix

As the purpose of the ERW risk assessment was to identify hazards and risks, this methodology was chosen through a fact-building questionnaire within an ERW risk assessment report. This methodology was chosen because it provides a systematic way of evaluating situations, ascertaining threats, collecting and analyzing information, and reporting pertinent facts and results to the client.

On completion of the ERW risk assessment report, all details were forwarded to the requesting agency along with details of any recommended risk-mitigation measures.

ERW Risk Assessment Results Analysis

The following section is an analysis of the collated ERW risk assessment resulting from the 214 facilities visited. The actual analysis was a two-stage process where the data was identified and organized into the preselected tables and then interpreted to gain a better understanding of the facts.

	UNRWA Schools	UNRWA Clinics	UNWRA Other	UNDP	UNICEF Schools	UNSCO	WHO Hospitals	UNESCO Education	NGO Education	Total
ERW RA Requests	100	12	34	15	26	3	9	14	1	214
ERW RA Completions	100	12	34	15	26	3	9	14	1	214

Figure 2. ERW risk assessment by agency.

Agency	RA's	A/C Bomb	155 mm Illum	155 mm HE	120 mm Tank HEAT	120 mm HE Mortar	105 mm Tank HEAT	80 mm HE Mortar	Mine	Grenade	Guided Missiles	Total
UNRWA Schools	100	0	30	0	32	6	41	0	0	1	7	117
UNRWA Clinics	12	0	1	0	0	0	5	0	0	0	0	6
UNRWA Other	34	1	3	0	4	0	1	0	0	0	0	9
UNDP	15	5	10	0	20	1	11	5	0	0	0	52
UNICEF Schools	26	9	37	0	68	13	5	0	1	0	0	133
UNSCO	3	0	6	0	0	0	0	0	0	0	0	6
WHO Hospitals	9	0	1	0	6	0	0	0	0	0	0	7
UNESCO Education	14	7	0	0	23	0	10	0	0	0	1	41
NGO Education	1	0	5	5	0	0	0	0	0	0	0	10
Total	214	22	93	5	153	20	73	5	1	1	8	381

Figure 3. ERW designation types.

Requesting Agency Type

The following summarizes which agencies requested ERW risk assessments:

- A total number of 214 ERW risk assessment requests were received and completed giving a 100 percent response rate.
- U.N. agencies accounted for 99 percent of the ERW risk assessment requests, with the majority of ERW risk assessment requests originating from UNRWA (146), followed by UNICEF (26); United Nations Development Programme (15); and United Nations Educational, Scientific, and Cultural Organization (UNESCO) (14).
- Educational facilities comprised 65 percent of the ERW risk assessment requests, while medical facilities comprised 10 percent.
- Although it was openly stated during all humanitarian meetings attended by UNMAS Gaza during the emergency response phase that UNMAS was available to help, UNMAS received only one request for an ERW risk assessment from an NGO.
- A relatively low number of UNICEF-supported schools were assessed by UNMAS Gaza because the Civil Protection Police (CPP) EOD teams conducted the majority of ERW risk assessments at the request of the Ministry of Education.

ERW Designation Type

A total number of 381 items of ERW (or component parts) were located and cleared with the assistance of the CPP EOD teams.

- The highest proportion of ERW type cleared was the 105 mm and 120 mm high-explosive anti-tank (HEAT) munitions, with 59 percent recorded. This ammunition is associated with the two main variants of the Merkeva main battle tank. These HEAT munitions were allegedly used to reduce collateral damage, as the munitions contain directional charges (as opposed to being omnidirectional) and have considerably less explosives.[6]
- For 60 percent of the 93 assessments where 155 mm illuminating artillery ammunition was cleared, the munition consisted of an empty illuminating projectile casing. It should be noted, however, that substantial damage was

sustained to many facilities due to the free falling casings, including one that entered the roof and exited the floor pan of a U.N. Special Coordinator's Office (UNSCO) B6 armored land-cruiser.

- In all assessments of guided missile use, the component parts recovered were thought to be those of Hellfire guided missiles.
- The only recorded use of a mine was an M-15 anti-tank mine that was used as a demolition charge to destroy a mosque adjacent to a Palestine Authority (PA) school; the mine only partially detonated with the remnants being thrown into the school grounds.
- All aerial bomb component parts matched that of the MK-80 series, low-drag, general-purpose aerial bomb.
- The only hand grenade recovered was an M26 hand grenade that was cleared following a family dispute at an UNRWA school, which was being used as a camp for internally displaced persons.
- All ERW items cleared, with the exception of the hand grenade and 120 mm mortars, originated from the IDF or the Israeli Air Force (IAF).

Structural Damage

Figure 4 provides analysis on the sustained structural damage:

- Of all facilities that were assessed, 70 percent received some degree of structural damage whether through direct fire or indirect fire, with 30 percent receiving no structural damage.[7,8]
- There was a higher proportion of ERW risk assessed facilities that received structural damage through indirect fire (53 percent) than direct fire (47 percent).
- Of the UNESCO facilities that were assessed, 92 percent were found to have sustained structural damage from either direct fire or indirect fire, with 73 percent of UNICEF-supported PA schools having sustained some level of damage.
- The damage ranged from Small Arms Ammunition (SAA) impact strikes to the total destruction of buildings and facilities by the use of aerial bombs.
- In addition to damage sustained from direct fire or indirect fire, some facilities also had direct damage from IAF armored bulldozers; this is especially the case for facilities located to the east of the Salah Ed Deen main arterial route.
- The one NGO facility, a children's nursery, was completely destroyed by tank projectiles, artillery projectiles, aerial bombs and armored bulldozers.

Evidence of Military Occupation

Evidence of military occupation is presented in the following narrative and in Figure 5:

- Only eight percent of ERW risk assessments saw evidence of any military occupation.
- This eight percent was only evident in UNRWA Schools and UNICEF-supported school facilities.

Aerial Bomb Clearance

- During the UNMAS Gaza emergency response, a total of 118 aerial bombs were destroyed with 16 neutralized by UNMAS Gaza prior to final disposal by detonation. The Ministry of Interior realized that not all EOD tasks can be undertaken by the CPP EOD teams due to limitations in their technical knowledge base and therefore requested UNMAS to render-safe the bomb fuzes.
- Conducting major EOD clearance- tasks within the post-conflict Gaza environment was and still is extremely complex due to the differing interlocutors that must be considered and consulted. It is of paramount

Agency	RA's	Direct Fire	Indirect Fire	Total
UNRWA Schools	100	25	42	**67**
UNRWA Clinics	12	1	7	**8**
UNRWA Other	34	13	14	**27**
UNDP	15	6	2	**8**
UNICEF Schools	26	13	6	**19**
UNSCO	3	1	0	**1**
WHO Hospitals	9	2	4	**6**
UNESCO Education	14	8	5	**13**
NGO Education	1	1	0	**1**
Total	**214**	**70**	**80**	**150**

Figure 4. Structural damage analysis.

Agency	RA's	IDF	Armed Groups	Total
UNRWA Schools	100	4	7	**11**
UNRWA Clinics	12	0	0	**0**
UNRWA Other	34	0	0	**0**
UNDP	15	0	0	**0**
UNICEF Schools	26	5	0	5
UNSCO	3	0	0	**0**
WHO Hospitals	9	0	0	**0**
UNESCO Education	14	0	0	**0**
NGO Education	1	0	0	**0**
Total	**214**	**9**	**7**	**16**

Figure 5. Evidence of military occupation.

importance that for any major EOD operation, prior approval must be gained from the Ministry of Interior, the UNRWA director and the UNMAS director, and all relevant information must be presented to the Coordinator of Government Activities in the Territories Unit in the Coordination and Liaison Administration for Gaza.

Aerial Bomb and Fuze Technical Analysis

A technical analysis on the 16 aerial bombs rendered safe including the following:

- All of the aerial bombs and 67 percent of the fuzes were of NATO origin and manufacture.
- Small diameter bombs accounted for 31 percent of the aerial bombs rendered safe; low drag general purpose bombs accounted for the remaining 69 percent.
- The 1000 lb aerial bomb was the most common aerial bomb type rendered safe, accounting for 43 percent of aerial bombs.
- An electronic multi-functioning aerial bomb fuze was the most common fuze type rendered safe, accounting for 38 percent of aerial bombs.
- During the render-safe operation, stuck-fast fuzes occurred in 25 percent of cases. With these aerial bombs, there was a medium degree of bomb body deformation through the initial impact with the target. This would have caused movement of the internal components within the aerial bomb, potentially leading to misfires and 31 percent of the aerial bomb fuzes had armed and partially functioned, but the detonating wave was not transferred into the booster element.
- In aerial bombs where both nose and tail fuzes could be fitted, only tail fuzes were used with inert aerodynamic plugs fitted in the nose cavity.

Summary

Ensuring the safety of staff during operations was of paramount importance and required that UNMAS Gaza effectively manage the ever-changing security situation through the creation and implementation of a specific security risk management system. This was only possible through the close coordination and facilitation of the UNRWA FSO, who was fundamental in the management of the security enabling environment.

Conducting ERW risk assessments was and is a sensitive and delicate process, as it deals with how hazards and risks are perceived and managed. In order to eliminate any personal bias during the ERW risk assessment procedure, it was vital that a formal and systematic ERW risk assessment procedure was agreed upon, documented, applied and reviewed. The defined ERW risk assessment methodology has been modified to suit the specific nuances of other ERW risk assessments within a phased response. Initially, the ERW risk assessment procedure was defined for the UNMAS emergency response phase and now has been modified for the UNMAS ERW reconstruction support phase.

The analysis of the ERW risk assessments from the 214 facilities visited was based on a relatively small sample number when looking at the quantities of explosive ordnance used and the damage and destruction within the wider context of the 2014 conflict. While in-depth, valid information was obtained, it should not be viewed as an exact representation of the situation Gaza-wide.

It should be noted that when managing the recovered data, a conscious effort was made to present "real impartial data" as opposed to unsubstantiated anecdotes. The data was simply presented in an unbiased manner with the intention of determining useful information and formulating conclusions to assist in the technical decision making process.

Collectively, the UNMAS emergency response findings and the results from the ERW response needs assessment provided the prerequisite information needed to accurately define the future UNMAS Gaza CONOPS. This has and will continue to ensure that appropriate technical assets and support mechanisms are in place for each operational phase, thereby ensuring that UNMAS continues to meet and exceed the expectations of all stakeholders involved.

See endnotes page 66

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ARMS MANAGEMENT AND DESTRUCTION PROGRAMMING: TAKING STOCK

by Chris Loughran and Djadranka Gillesen [MAG, Mines Advisory Group]

In Ségou, MAG built four armories, rehabilitated three armories and installed two containerized armories. To enable safe and secure management of weapons and ammunition, specialized equipment was installed at each site. This included bullet traps, adapted weapon racks, metal cabinets for long SA/LW and oversized weapons, and fire powder extinguishers outside the stores. Once the physical security was obtained, MAG provided training for staff.
All photos courtesy of Sean Sutton, MAG.

The Arms Management and Destruction (AMD) sector—an element of conventional weapons destruction (CWD) that includes several elements of physical security and stockpile management (PSSM)—has experienced dynamic growth over the last 18 months. An increasing number of programs address illicit and poorly stored weapons, enhance the safety and security of arms storage, and support the development of national capacity, including MAG's regional initiative in the Sahel and West Africa. As a distinct AMD sector emerges, now is the time to analyze what makes programming strategies effective as well as ineffective. The industry must resist the temptation to talk about best practice which distracts from the importance of tailoring AMD assistance to specific national contexts. Rather than seek to replicate projects, focus should be on identifying, sharing and embedding good practice, and the approaches that underpin successful programming in a specific national context.

Ensuring Needs-based Programming

Three years ago, MAG explained one of its key messages to donors: include and fund assessments, and develop assistance projects based on their findings. This followed a number of instances in which small arms projects were designed solely on the basis of national reporting under the U.N. Programme of Action and without technical assessment missions. When MAG engaged to deliver a project, successful delivery required significant reworking.

States took this on board and now support MAG to implement assessment-based AMD projects for weapons and munitions. Two years of assessments led to further refinements in

A MAG team conducts a technical armory assessment with the Gendarmerie in Koulikoro, Mali. MAG conducted technical assessments in Koulikoro in September 2014. After presenting its recommendations to the authorities and defining priority interventions, MAG began implementing AMD activities in Mali in early 2015.

MAG's approach. Assessments initially focused on the need and scope for weapons and munitions destruction, armory and explosive storehouse construction or rehabilitation, and the training required for storekeepers and managers.

These activities still form the core of assessments and subsequent assistance activities; they also ensure that programming is needs-based. However, MAG now undertakes assessments jointly with national authorities, ensuring that subsequent recommendations are fully owned nationally. MAG's approach assists authorities in determining their AMD needs, aiding the development of longer-term planning and prioritization of needs. This approach also enables development of accurate project costing. MAG expects this strategy will eventually support development of improved illicit small arms and light weapons (SA/LW) national action plans, by which the stockpile-management section is frequently underdeveloped.

Within the assessment, MAG also included stakeholder mapping and analysis in order to identify the activities and assistance already occurring, and the individuals, departments or organizations whose involvement is critical to successful programming. By including stakeholder mapping, MAG ensures complementary support and avoids overlap or duplicated efforts.

Replication of Good Practice

Needs-based assessments led by national authorities that incorporate stakeholder mapping are an example of good practice that can be replicated, precisely because they ensure tailored assistance to specific contexts. Comparing programs in various African countries illustrates this. In Mali, numerous national authorities and state-security providers identified an enormous need to address insecure weapons and munitions stores, as well as destroy unserviceable and obsolete weapons and munitions while assisting in the development of national capacity.

A large number of assistance providers are also available, including the United Nations, European Union, bilateral military aid and international nongovernmental organizations (NGO). A stakeholder-mapping approach and close coordination with donors and other assistance providers reduces overlap and increases interorganizational cooperation. In Burkina Faso, there has been a high level of engagement by the national authorities. However, a similar range of actors providing assistance does not currently exist. As the only international assistance provider, MAG's programming focuses on specific technical support and the development of a nationwide assistance plan to deliver and prioritize activities.

As the only AMD assistance provider in Chad, MAG is at an earlier stage of development and conducted a nationwide assessment of armories with the Gendarmerie and Garde

A weapon is issued after being logged out of an armory in Ségou.

As part of a request from the United Nations Mine Action Service (UNMAS), MAG worked with the Malian Defence Security Forces (MDSF) from October 2014 to destroy more than 10,000 weapons. MAG completed the destruction in January 2015. Before commencing the cutting of weapons, MAG provided training in weapons cutting in October 2014 for 12 personnel identified by MDSF.

Nationale et Nomade du Tchad. This aims to act as the basis for future operational activity while also developing trust and demonstrating to other state-security providers the benefits of AMD programming.

MAG has conducted AMD programming in Democratic Republic of the Congo for nearly a decade. MAG's longer-term presence led to a high degree of trust and partnership with the armed forces and police. A weapons-destruction facility in Kinshasa, established with funding from the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), runs under national management with minimal technical oversight. MAG's assistance also included support to the development of national technical guidelines led by the European Communications Security Evaluation Agency working group.

These programs are just a few examples of how AMD programming is tailored specifically to the local context, need and capacity while also complementing other avenues of assistance. These examples demonstrate how good practice and replication of AMD programs should focus on the approach taken rather than assuming that a successful project in one country can be replicated with guaranteed success.

When AMD involves the safe and secure storage of ammunition, the IATGs reflect this approach to good practice. The IATGs aim to provide a global, guiding framework that informs development of standards and implementation practices at the national level. Context-specific approaches are built into their structure, as is the principle of incremental good practice across three levels.[1]

Within the IATGs, MAG's assistance focuses on supporting states to achieve Level 1, which will make progress toward preventing unplanned explosions and diverting munitions to illicit markets in even the most challenging contexts. Projects based on assessments that involve relevant national authorities and consider wider stakeholders, programming and assistance have the best chance of success.

Where Next?

By the time this article is published, a number of important meetings involving stakeholders in the AMD sector will have convened, particularly a meeting on ammunition life cycle management (hosted in Switzerland) as well as efforts to improve coordination in the Greater Sahel, led by Germany and the African Union. These discussions are unlikely to change

Major Arme Amoya, storekeeper, Ségou Police. "I am very happy with the container and the way it is organized. All gun racks have padlocks. The training went very well and I learned a lot. I am from the old school and I didn't receive any training. I became a storekeeper because of trust rather than training. Now I am trained, I was recently promoted to work in a bigger armory. I will make sure to pass on my knowledge to my replacement—but I will keep the manual MAG gave me."

the scope of AMD assistance activities significantly, as activities will continue to focus on destruction of conventional weapons; construction and rehabilitation of armories and explosive stores; and training and capacity building of national authorities, security agencies and armed forces. However, these will be vital steps in defining the future direction of the AMD sector by concentrating on coordination in AMD programming, defining end states for international assistance, programming effectiveness, and measuring success and sustainability.

The period ahead is important for further developing an AMD sector separate from mine action and where programming approaches can continue to evolve and improve. The AMD sector must deepen its understanding of how assistance efforts support conflict prevention and broader security-sector reform efforts. To be successful, we must continue to develop a culture that embraces critical self-reflection while deepening and broadening dialogue and partnership.

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MAG's arms management and destruction work in Mali is supported by the German Federal Foreign Office, who along with PM/WRA, fund MAG's Sahel-West Africa program.

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In the Spotlight

EASTERN EUROPE AND THE CAUCASUS

GICHD's Eastern Europe, Caucasus and Central Asia Outreach Programme

by Faiz Paktian [Geneva International Centre for Humanitarian Demining]

EECCA workshop participants visit the ERW response center of the Ministry of Interior of Belarus.
Photo courtesy of GICHD.

Within the Eastern Europe, Caucasus, and Central Asia (EECCA) region, fifteen countries affected by landmines and/or explosive remnants of war (ERW) use Russian as a communication language: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Mongolia, Moldova, Russia, Tajikistan, Ukraine and Uzbekistan. Mines and ERW pose a serious hazard to the lives and livelihoods of the people in the EECCA. Residual contamination impacts many of the countries. In Belarus for instance, 20,879 items of unexploded ordnance (UXO) were found and destroyed in 2014.[1] Significant amounts of UXO were also recovered from Estonia, Moldova and Russia. More recent conflicts led to considerable mine and ERW contamination in countries such as Armenia, Azerbaijan, Georgia, Tajikistan and Uzbekistan. In Ukraine, clearance priorities from the current conflict superseded clearance of WWII ERW. In 2014, 36,500 items of UXO in the areas of Donetsk and Luhansk were reportedly destroyed.

Aging and poorly managed ammunition stores also resulted in numerous unplanned explosions that killed many civilians living close to depots in several of the EECCA countries. Furthermore, insurgents use poorly secured or abandoned ammunition as sources of highly explosive material for the production of improvised explosive devices. To improve human security and the safety of civilian populations in EECCA, clearing mines and scattered items of ERW is imperative as well as securing and managing all ammunition stores to recognized international standards.

In June 2015, the Geneva International Centre for Humanitarian Demining (GICHD) established a platform of affected states and regional organizations to advance human security across the region through improvements in the mine action sector. The purpose of the Eastern Europe, Caucasus, and Central Asia Outreach Programme (EECCA-OP) for mine/ERW action is to promote safe and efficient implementation of mine/ERW action projects and programs, to enhance regional cooperation through information and experience sharing, and to embed the best mine/ERW action practices throughout the region. The EECCA program will assist national mine action authorities and local operators to accelerate capacity development through access to international standards, training material and advisory services in a more accessible language.

First EECCA Regional Workshop in Minsk

GICHD, in partnership with the Ministry of Foreign Affairs and the Ministry of Defense of the Republic of Belarus, organized the first regional workshop in Minsk 9–12 June 2015. Thirty-five participants from 10 countries and representatives from international organizations active in the region attended the workshop.

Workshop objectives were as follows:

- Assess and thereby understand the scope of the mine/ERW problem and the challenges faced by different countries in the region.
- Promote best practices and share lessons learned in ammunition-safety management and mine/ERW action.
- Enhance cooperation in planning and implementing mine/ERW action programs among all states in the region.
- Discuss priorities and initiate regional workshops and activities that benefit mine/ERW programs and military personnel in the EECCA region.

Workshop Recommendations

The workshop concluded with the following recommendations for GICHD's EECCA-OP:

- Establish a mine action website for EECCA in the Russian language.
- Translate International Mine Action Standards (IMAS), International Ammunition Technical Guidelines (IATG) and other relevant documents into Russian.
- Hold a regional, annual gathering for EECCA countries and partners to review progress and establish priorities.
- Invite countries absent during the first EECCA gathering, such as Kazakhstan, Latvia, Lithuania, Mongolia and Uzbekistan, to future gatherings.
- Organize a visit for the national authorities to a well-established mine action program in the region.
- Offer technical regional workshops in Russian on the following topics: development of national law and standards, IMAS application, strategic/annual planning, ERW survey and clearance, ammunition-safety management, accreditation and contracting, risk education, and victim assistance.

Action Plan 2016

GICHD's EECCA-OP plans to deliver the following in 2016:

A mine action website in Russian. The website will be a platform to post and disseminate mine action information and news, including up-to-date information on mine action programs and topics in the Russian language. Russian-speaking visitors can sign up for news and information as well as participate in discussions on mine action issues. The purpose of the website is to make essential mine action information and documents available in Russian, and to promote common mine action terminology and best practices throughout the region. GICHD will be responsible for maintenance and content.

Translation of IMAS and IATG into Russian. IMAS, IATGs, and the associated documents and tools in the Russian language will increase understanding and promote a common and consistent approach to the conduct of mine action operations and ammunition-safety management. They will assist the national authorities to adopt best practice, develop national standards and assist implementing organizations to improve standing operating procedures. As a result, these will contribute to the safety, efficiency and quality of mine action operations and ammunition-safety management in the region.

Field seminar to the mine action program in Azerbaijan. A visit to the mine action program in Azerbaijan in consultation with the Azerbaijan National Mine Action Authority is planned for 2016. Its purpose is to expose the countries of EECCA to an established mine action program in the region. During the visit, representatives of mine/ERW action programs and military personnel engaged in humanitarian tasks will have the opportunity to exchange views and experiences on all aspects of management and field operations, including risk education and victim assistance.

Organization of a side event during the National Directors Meeting. GICHD will organize a side event at the International Meeting of National Programme Directors and U.N. Advisors in Geneva. Representatives of EECCA countries at the meeting will be invited to share ideas and

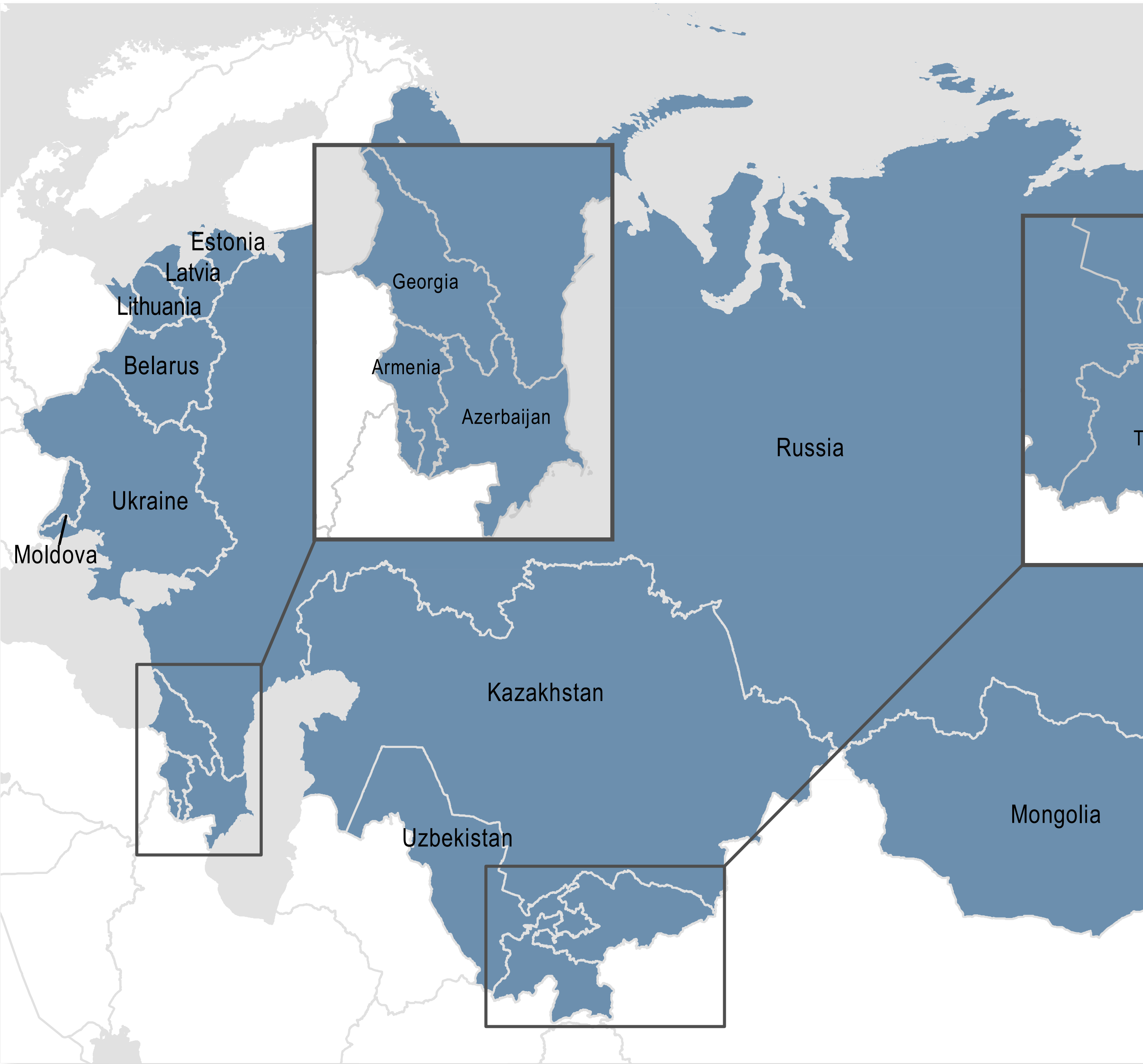

Figure 1. **Eastern Europe, Caucasus and Central Asia (EECCA) Outreach Programme.** The GICHD supports national authorities, international and regional organizations and NGOs in their efforts to improve the relevance and performance of mine action. It serves as the leading multi-lingual knowledge hub for mine action practitioners. The GICHD furthers knowledge and promotes norms and standards in Russian, fostering regional and intersectoral cooperation. Disclaimer: The map above is for illustrative purposes and does not imply the expression of any opinion on the part of the GICHD concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries. Some countries/territories highlighted in this map may not have landmine/ERW contamination.
Figure courtesy of GICHD.

thoughts on upcoming events and the future of the EECCA-OP. The event is a valuable opportunity in February 2016 to inform the group about its activities and encourage financial, in-kind and academic contributions of the partners, as well as review progress and plans.

Second EECCA Annual Conference

The second EECCA annual gathering is planned for the second half of 2016. In this event, national authorities in the region will not only discuss progress made but also share lessons learned, future challenges, and updates on mine action operations and ammunition-safety management. The needs of the programs will be assessed in order to identify priorities for 2017.

Technical Workshop

GICHD will organize a technical workshop in an EECCA country with a focus on norms, standards and legislation. Countries will share their norms and laws with regard to mine action and ammunition-safety management as well as discuss challenges and lessons learned regarding these topics.

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Unfinished Business: Cluster Munition Remnants in Kosovo

by Dr. Darvin Lisica and Dr. Stuart Maslen [Norwegian People's Aid]

During the period of June 1999 to mid-December 2001, the United Nations Mine Action Service (UNMAS) coordinated major international cleanup activities in Kosovo, which resulted in the successful clearance of more than 12.4 sq mi (32.1 sq km) of land and the destruction of more than 50,000 landmines, unexploded submunitions and other unexploded ordnance (UXO). Kosovo had considerable mine and explosive remnants of war (ERW) contamination, including cluster munition remnants (CMR) from armed conflict between forces of the Federal Republic of Yugoslavia and the Kosovo Liberation Army in the late 1990s, exacerbated by the NATO bombing in 1999.

Time has shown how much remains to be cleared (and sometimes re-cleared). At the time of the U.N. program's closure on 15 December 2001, 47 task dossiers remained. Despite years of further clearance, a community liaison survey completed by The HALO Trust in 2007 identified 172 mine or ERW clearance tasks.[1] The national authorities, then the Office for the Kosovo Protection Corps Coordinator (OKPCC), advised by the Geneva International Centre for Humanitarian Demining (GICHD), discounted 42 of these tasks after re-survey. However, HALO's clearance operations in 2009 continued to find contamination in other areas that OKPCC did not consider dangerous.[2] By the end of 2014, 128 confirmed hazardous areas (CHA) remained in the IMSMA database held by the Kosovo Mine Action Centre (KMAC), covering a total area of almost 4.1 sq mi (10.6 sq km).[3] Of this total, contamination from CMR was strewn across 51 areas covering more than 2.9 sq mi (7.5 sq km), including majority Serb areas in northern Kosovo.[4,5]

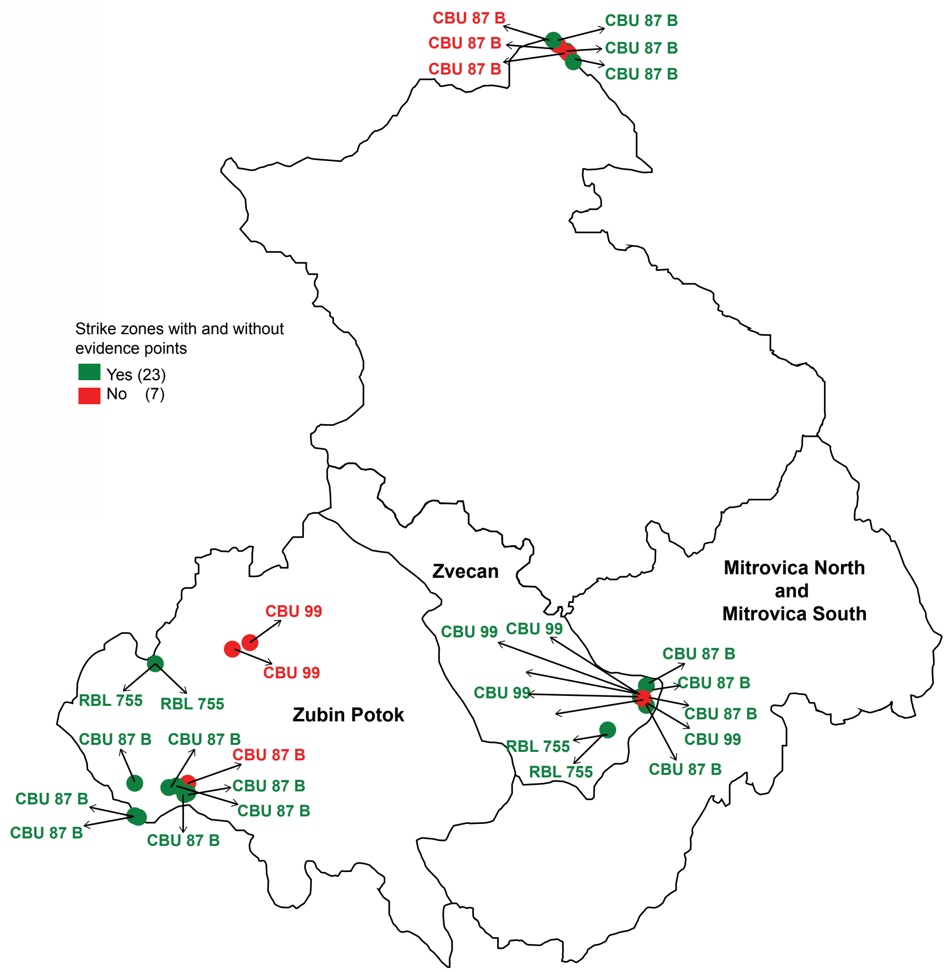

Figure 1. Cluster munition strike zones in northern Kosovo identified by NPA.
All graphics courtesy of NPA.

In 2014, Norwegian People's Aid (NPA) established a new program in Kosovo and took a careful look at CMR in northern Kosovo (specifically the four municipalities of Leposavić, Mitrovica North, Zubin Potok, and Zvečan). From December

Unexploded BLU-97 submunition at Tovariste in Zăză community, Zvecan municipality.

2014 through July 2015, NPA conducted desk study and field-based, non-technical survey (NTS) to assess and confirm CMR contamination. These activities were done in partnership with local authorities and KMAC.

NPA identified cluster munition strikes in nine affected communities across three of the four municipalities (Leposavić, Zubin Potok, and Zvečan). Four types of cluster munitions were identified: CBU-87/B (in three versions, dispersing BLU-97, BLU-97B or BLU-97A/B submunitions), CBU-99 (dispersing MK-118 BL submunitions), BL-755 (dispersing MK-1 submunitions) and RBL-755 (dispersing MK-4 submunitions). Records of unexploded submunitions clearance by the NATO-led Kosovo Force (KFOR) were provided to NPA by KMAC, indicating total clearance on four tasks at one location (Mokra Gora) in 1999 and 2006 of some 750,000 sq yards (632,800 sq m)—though it is unclear if these clearance operations were conducted in accordance with international mine action standards.[6]

During this planned clearance, 119 unexploded submunitions were found and destroyed, while KFOR units destroyed 299 additional submunitions in spot tasks after calls from local communities. The majority of these 276 submunitions were found in Žaža community in Zvečan municipality in 2000. In 2015, KFOR reported the latest incident, a single unexploded submunition in Oklace, Zubin Potok municipality.

Available information suggests that during the bombing campaigns, 83 cluster bombs were dropped at 30 locations within the three municipalities, dispersing a total of 17,041 submunitions. NPA estimated that 1,459 unexploded submunitions remained (8.56 percent of those fired overall), indicating up to 1,000 or more still need to be cleared from almost 9 sq km of land (3.4 sq mi). These figures are in addition to the already significant KMAC estimates of contamination cited previously.

Boljetin is one of the affected communities situated in the southeast of Zvečan municipality, where most of the land is forested or pasture. The community has a population of approximately 350, of whom only about 45 citizens are permanently employed.[6] Most of the unemployed exploit the forest, use the pasture, or conduct agricultural and orchard work as their main source of income. No data were available on NATO bombing of the community. During NTS, NPA received information from local authorities and from the field that NATO had bombed one location on Sokolica Hill. Municipality authorities confirmed this information, which stated that detonations occurred due to a forest fire in July 2007 north of Sokolica monastery.

Based on information received locally, NPA confirmed two NATO strikes in the community. The local population confirmed they feared entering the area surrounding Boljetin village and Sokolica monastery. The police station in Zvečan was also informed by paragliders that they noticed unexploded submunitions from the air. The total hazardous area is 0.06 sq mi (0.15 sq km) or about 30 soccer fields. NPA estimated that at least two RBL-755 cluster bombs were dropped, dispersing

Unexploded BLU-97 A/B submunition at Crni Krs in Oklace community, Zubin Potok municipality.

A child finds parts of a BLU-97 submunition in Oklace, Zubin Potok municipality.

MK-4 submunitions. NPA estimated that 30 MK-4 submunitions remained for clearance.

Although KFOR emergency interventions reduced the hazard level at certain locations across the region, serious risks for the local population still exist, and risks are growing as local communities in northern Kosovo begin using the land more extensively for economic development. Analysis shows that across northern Kosovo, mountainous areas intended for tourism (a key development potential for the region) amounted to 42.5 percent of the total contamination identified. Agricultural land (24.8 percent) and forests (23.2 percent) are also highly impacted. The remaining impacts were on areas used or intended for housing, infrastructure, river banks and canals. In total, assessments indicate that 3,872 people are impacted by the presence of unexploded submunitions with 995 people at direct risk of death or injury.

Based on its assessment of the CMR hazard and impact, NPA plans to develop a land-release strategy for contaminated areas across all of northern Kosovo, including areas with Serbian and Albanian majorities. More than 15 years after cluster bombs were dropped, northern Kosovo still faces a major clearance challenge.

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Provision of Emergency Risk Education to IDPs and Returnees in Ukraine

by Abigail Jones and Edward Crowther [Danish Demining Group/Danish Refugee Council]

Volunteers conduct an MRE session with children, 2015.
Photo courtesy of Sasha Lobov.

While no official survey of the landmine/explosive remnants of war (ERW) situation has been carried out in Ukraine, the humanitarian impact is significant. Mines and booby traps strategically block access to essential infrastructure as well as to forested areas where people gather wood to heat their homes. Important infrastructure across the Donbas region, one of Europe's most heavily industrialized areas, is contaminated, slowing repairs and reconstruction around power stations and water-treatment facilities, and seriously affecting the local population. Similarly, cluster munition use in urban and rural areas blocks access to family allotments and farms.

The media, humanitarian nongovernmental organizations (NGOs) and civilian volunteer networks report mine/ERW casualties in Ukraine. Different government ministries formally collect data on these incidents, but it is not available publicly. Although no clear baseline exists, the number of casualties from mine/ERW accidents has risen in recent months as internally displaced persons (IDPs) start to return home, and the rehabilitation and reconstruction of essential infrastructure has taken place. Danish Demining Group's (DDG) informal monitoring of open-source news and data suggests that since May 2014 at least 338 reported accidents occurred involving mines/ERW, with 41 children and 686 adults killed or injured.

A Results-based Approach to MRE

DDG has, over the last 18 months, begun a global change in the way it understands and provides mine risk education (MRE), as explained in a presentation entitled "More than Posters" by Tammy Hall, head of DDG, at the 17th International Meeting of Mine Action National Programme

Training of KAP survey enumerators in Severodonetsk, Ukraine, 2015.
Photo courtesy of Olena Sadovniko.

Directors and U.N. Advisers in Geneva in February 2015. An earlier article by DDG Chief Technical Advisor Robert Keeley in *The Journal of ERW and Mine Action* (Issue 19.2, July 2015), describes the principles of this approach.[1] The DDG MRE program in Ukraine is results-based, and has in turn fed back into DDG's understanding of how to plan and conduct MRE in other programs.

Implementing the Knowledge, Attitudes and Practice Survey

Through a grant funded by the United Nations Children's Fund (UNICEF), DDG carried out a knowledge, attitudes and practices survey (KAP) in April 2015, to ensure that MRE messages and methodologies target the needs and capacities of different categories of risk takers in the community. The KAP survey included the following target groups:

- **IDPs**: Adults and children displaced as a result of the conflict, residing in government-controlled areas. IDPs have settled across the country, with the most vulnerable living in collective centers.
- **Returnees:** Adults and children in the process of returning to conflict-affected areas under government control. Back-and-forth movement and returns continue to be reported from the field, as IDPs and refugees return to secure property, assess the conflict environment and visit relatives either unwilling or unable to leave the conflict zone.
- **Residents:** Adults and children residing in conflict-affected areas under government control, including residents in their place of origin. In terms of residents, limited data is available to show how many people stayed in the regions where the highest intensity fighting took place.

The KAP focused on identifying MRE needs for each affected group, particularly for children aged six to 11 and 12 to 17. While the main focus of the KAP survey was to identify children's MRE needs, surveyors also took the opportunity to understand more about the risk-taking behaviors of adults.

In total, the KAP survey covered 699 individual interviewees in the government-controlled areas of Luhansk and Donetsk oblasts. Broad categories of target groups interviewed included a total of 341 IDPs (48.8 percent), 348 residents (49.8 percent) and 10 returnees (1.4 percent) in both

Training of trainers for Luhansk Oblast school teachers, 2015.
Photo courtesy of Edward Crowther.

oblasts. In Luhansk, 215 were IDPs, 132 were residents and three were returnees, while Donetsk had 125 IDPs, 216 residents and seven returnees. The total sample consisted of 397 (57 percent) female and 302 (43 percent) male respondents.

In eastern Ukraine, the KAP confirmed boys and girls from ages six to 11 are the least aware of the dangers posed by mines/ERW, since a high percentage (42.8 percent) cannot properly identify dangerous items and do not know what is appropriate, safe behavior. The KAP also established that all adult groups and children from the ages of 12 to 17 may be treated as uninformed due to insufficient knowledge about how to handle victims of mine/ERW accidents. A low number of respondents (1 percent), typically males from the ages of 12 to 17 and 35 to 59, admitted **recklessness**. However, analysis of available data on casualties demonstrates that many of the accidents were a result of reckless behavior. Equally, males and females ages 18 to 60 stated survival as justification for their unsafe behavior, citing activities such as farming, grazing cattle, going to work and gathering firewood. This behavior places these groups in the category of **intentional**. Elderly men ages 60 and over may, as a result of the available data, be characterized as **misinformed**.

Using the Results of the KAP

The findings of the KAP were used to develop an approach that aims to increase safety and security of school-aged children and their parents in and around learning spaces and schools by increasing awareness of mines/ERW. Utilizing the results of the KAP survey ensured that emphasis was placed on key messages covering identified gaps in knowledge among the target population. For example, the KAP determined that knowledge about mine warning signs was insufficient, and emphasis on this has been included in the training. Moreover, many KAP respondents could not recite the correct number to call for the Ukrainian State Emergency Services to report mines /ERW; this has also been given strong emphasis.

“In eastern Ukraine, the KAP confirmed boys and girls from ages six to 11 are the least aware of the dangers posed by mines/ERW”

DRC/DDG children's MRE flipchart, 2015.
Photo courtesy of DDG Ukraine.

The project is ongoing and includes five core activities:

- Training of up to 100 teachers and school psychologists as trainers in partnership with the Ministry of Education to ensure that IDP and returnee children are provided with MRE-integrated school activities. So far, 84 teachers and school psychologists across the eastern oblasts most heavily affected by the conflict have received training.
- Training of up to 127 volunteers from Ukrainian NGOs, church-based groups and other community-based organizations working in conflict-hit communities across the eastern oblasts.
- Peer educators in summer camps were trained to ensure the active participation of youth in MRE activities. Summer camps across Ukraine are places where large numbers of IDP children are sent during the summer, and training summer-camp peer educators can provide these children with MRE in an efficient and entertaining way.
- Innovating mine action through Mine Action Applications (MApps). DDG is designing, developing and piloting an innovative two-way communication web portal and parallel SMS service that aims to improve the service provision and information exchange between conflict-affected people and the mine action operators assisting these communities. MApps Ukraine is part of a global pilot project on digital applications for mine action.
- In collaboration with UNICEF Ukraine, DDG is working to design and disseminate an information-education campaign through TV as well as digital and print materials to raise awareness on mine/ERW risks and to promote safe practices. The KAP survey indicated a desire to receive MRE messages via channels such as TV and social media.

DDG also works closely with UNICEF in Ukraine in order to standardize the child- and adult-focused MRE materials used by organizations providing MRE across Ukraine. In this respect, the KAP survey is invaluable in driving the design of such materials.

Despite these activities, the amount of MRE provided in the eastern oblasts of Ukraine is insufficient, and DDG receives daily demands from communities and organizations in the conflict-affected areas to provide MRE training or sessions. Under a new EU€1.57 million (US$1,730,375 as of 22 February 2016) European Union (EU)-funded project, DDG will significantly scale up its activities providing MRE across Donetsk and Luhansk, working with community-based organizations and the school system. Another aspect of the EU project will provide modern equipment and International Mine Action Standards-level training to pyrotechnical units of the state emergency services working in the eastern oblasts.

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Explosive Hazards in the Aftermath of Natural Disasters: Lessons Learned

by Nicole Neitzey [Center for International Stabilization and Recovery]
and Dr. Paula Daly [James Madison University College of Business]

Natural disasters have posed problems for demining operations in the past; the heavy flooding in Bosnia and Herzegovina was one recent example of many. Over the past 20 years, natural disasters have impacted countries affected by landmines or other explosive remnants of war (ERW), causing renewed danger. Figure 1 lists the main challenges faced in situations such as these. Despite reoccurring in recent years, these events continue catching the international CWD community by surprise, while experience and lessons learned from previous disasters in one country must be relearned in other regions.

With the flooding in Bosnia and Herzegovina, experts realized that 15 years of clearance progress could be effectively washed away in a matter of hours. As shown in Figure 1, a disaster in an area contaminated with explosives can affect everything from trade routes to peoples' lives and livelihoods. The issues at hand include how to reassess the ERW threat, how to minimize loss of life and cost, how best to educate the public and relief workers of potential dangers, how to reprioritize the deployment of ERW-clearance assets, and when and how to determine if areas are safe for displaced populations to return. With such high stakes, it is imperative that we as a community do our best in planning for the possibility of a disaster disrupting normal operations.

Hurricane Mitch (1998)	**Honduras and Nicaragua**
• Demining operations halted for roughly a month while resources were diverted to emergency relief • Infrastructure (roads, bridges, etc.) destroyed • Mines shift, clearance requires more time and resources • Demining equipment lost[1]	
Massive Floods (2000)	**Mozambique**
• Mines migrate from marked areas to those previously deemed safe • Over 200,000 people lost their homes • Additional resources needed • New national plan needed to identify and prioritize new hazards[2,3]	
Flash Floods (2010)	**Pakistan**
• Floods carry mines from mountains to nearby tribal area • Individuals unaware of dangers touch explosives, causing injuries[4]	
Heavy rains cause floods (2011)	**Sri Lanka**
• Landmines/ERW previously buried dislodged and moved • Resurveying needed to assess hazard areas and severity[5]	
Heavy rains flood border area (2012)	**Peru/Chile**
• Border closed when mines surface on the roadway be-tween the two countries, halting all trade along this route[6]	
Flooding (2013)	**Cambodia**
• Due to the sheer number of mines,, fears that migrated mines would resettle in new areas before all could be found[7]	
Floods / landslides from extreme rain (2014)	**Bosnia and Herzegovina**
• Tens of thousands of mines displaced • Reports of mines and ERW shifting from marked areas to unknown locations • Safe roads for relief and debris clearance teams to travel not immediately clear[8,9]	

Figure 1. Major challenges of past natural disasters in ERW-affected areas.
Figure courtesy of authors.

ERW in the Immediate Aftermath of Natural Disasters: A Complex Problem

Following flooding in Bosnia and Herzegovina in 2014 that some experts feared would significantly set back the country's ERW clearance program, the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA) asked the Center for International Stabilization and Recovery (CISR) to research the issue. The main purpose was to incorporate the findings into a training module for CISR's Senior Managers' Course in ERW and Mine Action to help CWD program managers understand and prepare for the issue of natural disasters interrupting their operations.

Landmines and other ERW affect the lives and livelihoods of people in more than 60 countries or territories worldwide.[10] Lingering conflict and renewed hostilities in unstable parts of the world mean that new threats from landmines, unexploded munitions and improvised explosives often continue to arise. Natural disasters similarly pose grave risks to people's lives, communities and societies. An average of 388

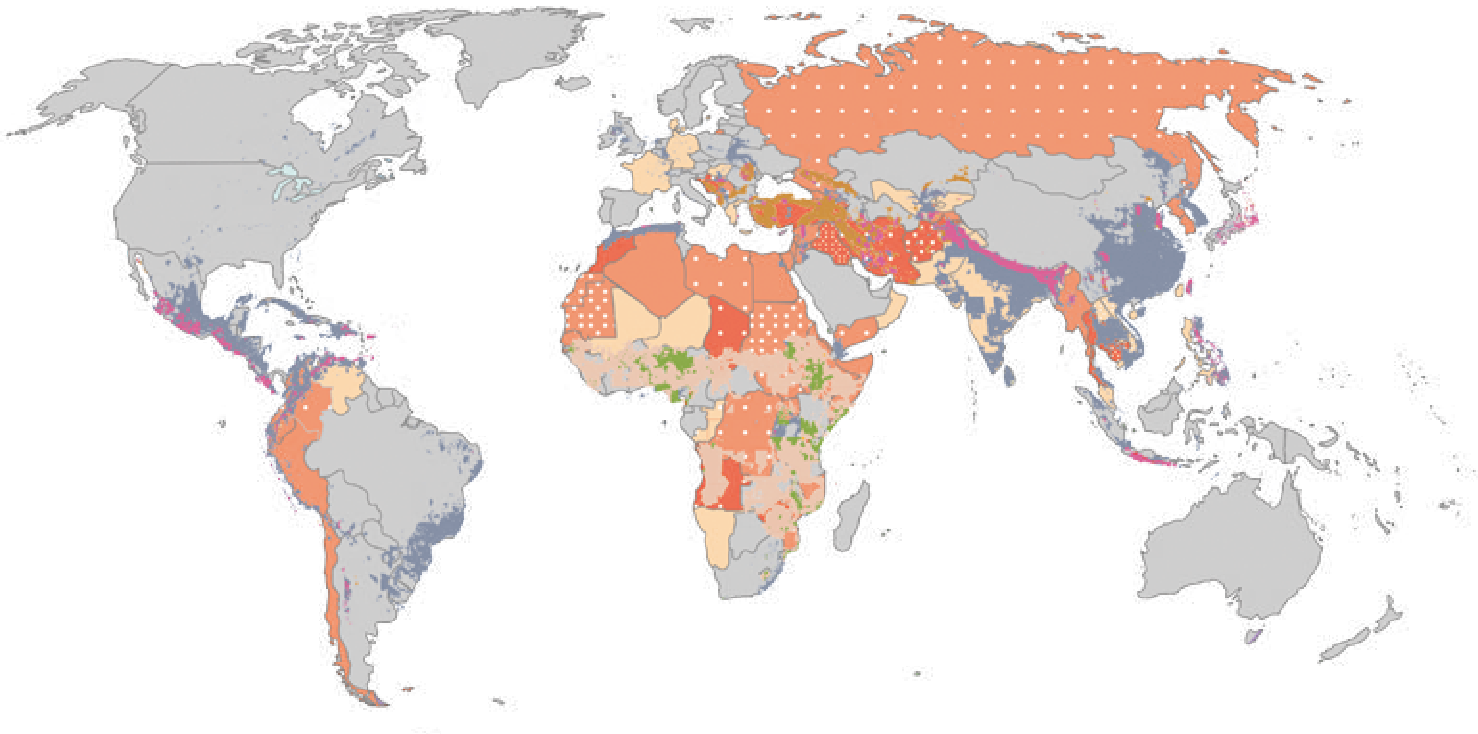

Figure 2. The map highlights countries affected by ERW and areas at risk from natural disasters (includes earthquakes, volcanoes, floods, cyclones and landslides).
Figure courtesy of ICBL, Cluster Munition Monitor, Mines Action Canada, World Bank and CISR.

natural disasters was observed annually from 2003 to 2012 with more than 106,000 people killed by natural disasters on average each year during the same time period.[11] Economic damages of disasters average tens of billions of dollars per year globally.[11] Conflicts and disasters cause people to flee their homes: A 2014 report on effects of natural disasters states "almost 22 million people were [newly] displaced in at least 119 countries [in 2013], almost three times as many as were newly displaced by conflict and violence."[12] The number of people newly displaced by conflict is only a small piece of the picture, as conflicts often linger for long periods. In 2013, the United Nations High Commissioner for Refugees estimated that more than 51 million people were considered forcibly displaced globally—an aggregate figure that includes those remaining in a state of displacement from previous years and is the highest number on record since these figures were tracked.[13] Estimates indicate that less than 2 million people were able to return home in 2013, and more than 6 million fall into the category of a "protracted refugee situation," having been displaced for five years or more.[13]

Compounding the threat of disasters in ERW-affected areas is the fact that their frequency and impact have risen over the past three decades and are predicted to increase.[14] A 2011 Oxfam research report posits that the increase in the number of disasters is partially attributable to global climate change, and escalated impact is tied in part to population growth.[14] Vulnerability, defined as being "affected by economic, social, physical, environmental or political conditions, which increase the susceptibility of a community to the impact of hazards," also plays a role in exposure.[14] Clearly countries devastated by war and still recovering from the effects of leftover explosives would fall into the "vulnerable" category. A 2014 report by the Norwegian Refugee Council further details the overlap of conflict-affected regions with natural disasters in recent years: "In 33 out of 36 countries affected by armed conflict between 2008 and 2012, there were also reports of natural hazards forcing people to flee their homes."[12] Further, the displaced may be forced to move to areas that expose them to additional risk, magnifying their vulnerability.[12]

Countries in these situations often have limited capabilities at the national level to respond to either their residual ERW problem or the aftermath of a natural disaster as an isolated problem—let alone the combination of the two.[15] Nations heavily affected by ERW are typically highly reliant on international support (at least in terms of funding and sometimes technical capacity), and international recovery efforts for disasters in developing countries function in much the same way—led by external donors and relief workers. Unless previously engaged in operations under conditions involving ERW dangers, external actors entering to provide aid following a natural disaster may be unaware of the potential hazards. Figure 2 illustrates the large amount of overlap between countries vulnerable to disasters and those affected by ERW contamination.

Disaster Management: A Framework for Addressing Risk

A robust history of planning and implementing responses to mine/ERW cleanup and natural disasters exists; the two are largely separate fields, but each can inform the situation that occurs when the two overlap. The literature on natural disasters identifies four phases of disaster management: prevention (or mitigation), preparedness, response and recovery (see Figure 3).[15] Experts believe that governments and organizations should address all four phases to adequately tackle natural disaster risk.[15] At issue are matters such as gathering information, coordination, prioritization, redefining impact and needs, roles of different actors, providing appropriate training, interruptions to operations, cost, emergency public information campaigns, international assistance, ensuring the safety of relief workers vis-à-vis explosive hazards, and integrating CWD programs with larger relief efforts. In addition to these concerns of preparedness and response is the possibility that some risks could be avoided or prevented.

Figure 3. The four phases of disaster risk management.
Figure courtesy of http://securipedia.eu/.

Additionally, aspects of disaster preparedness can assist in understanding ERW emergencies related to natural disasters. Such topics as immediate relief mobilization, lines of authority, information gathering, interorganizational coordination and public information campaigns/educational aspects can be overlaid with the explosives issue, as similar concerns are in both areas. Since a strong history of disaster planning and preparation is evident in various countries worldwide, this topic not only helps us understand the problem at hand but also provides potential solutions to mirror in the field of CWD within the context of natural disasters. The U.N.'s International Strategy for Disaster Reduction provides a useful framework for considering the relevant issues based on its stated goals for disaster and risk reduction in which it strives for increased public awareness of risks, commitment by public authorities to risk reduction, engaged involvement of the public in risk reduction, and reduced economic and social losses due to natural disasters.[16] These areas can be translated to the issue of ERW hazards in the wake of natural disasters to provide a holistic response to ERW in the aftermath of a catastrophic natural event.

Risk Management and Organizational Continuity: Managing Large-scale Disruptive Events

Working with CWD personnel means working with managers who routinely try to accomplish their organizational goals in high-risk environments or situations. On a regular basis CWD employees may face physical danger from unexploded ordnance, political instability, hostile environmental elements or sudden loss of funding. Handling large-scale disruptive events (i.e., crises) is an additional complexity for managers and other personnel who already cope with unique challenges in their work environment. The primary goal of incorporating risk management into the managerial training component of CISR's Senior Managers' Course is to help managers develop the knowledge base and skill set that allow them to achieve the mission of their organization regardless of disruptions that happen along the way.

The concept of **organizational continuity** is borrowed from **business continuity** literature and modified to fit non-business entities. Continuity management is an approach that identifies potential disruptive events and provides a framework for building resilience, which is an organization's ability to withstand the impact of a major disruptive event. Effective response to such an event means that an organization has the capability to respond in a way that protects key stakeholders,

> "Understanding risk is the starting place for organizational continuity and the effective management of disruptive events."

value-creating activities, the environment, and organizational integrity and reputation. Organizational continuity and risk management are closely linked and mutually dependent. Risk management tends to be more preventive in nature and provides important inputs for managing organizational continuity. Managing continuity goes beyond risk management to include in-depth planning on how to deal with events and their consequences.

Understanding risk is the starting place for organizational continuity and the effective management of disruptive events. A key principle underlying risk management is that risk cannot be eliminated but can be controlled. The amount and type of control exerted depends on the likelihood of the event occurring and the magnitude of impact (or loss) associated with the risk. Although risk can sometimes be quantified, often the information needed to do so is either unavailable or too expensive to collect. Risk analysis is the process of identifying events, determining causes, and estimating probabilities and impacts. It includes the following steps:

- Identify **significant threats** to critical operations.
- Identify and evaluate current **controls**.
- Estimate event **probabilities**.
- Estimate **impacts**.
- Utilize a **risk measure** combining impact and probability
- **Prioritize** risks and determine **treatment**.

The organizational continuity approach ties crisis management more closely to an organization's overall strategic plan. To effectively manage disruptive events and build resilience, managers must understand how these events impact the activities critical to the organization's mission. An organizational impact analysis addresses three critical questions:

- What are our primary objectives?
- What deliverables are critical to our organizational purpose?
- What resources are critical to our ability to continue producing those deliverables?

Disaster Risk in ERW-affected Areas: Identifying Risks

In order to adequately address the risk of disaster in ERW-affected areas, protocols are needed to deal with risks in a systematic way. Using the disaster-management framework in Figure 3, managers in CWD programs should think about resolutions in each phase to address risk. Consider what questions you, as a manager, need to ask in order to prepare for a disruptive event. Some of the recommended questions to consider within each of the four phases are outlined here.

Prevention/Mitigation. In the area of prevention/mitigation, remember that disasters typically cannot be prevented, but their impact can be mitigated. Managers should keep this fact in mind as they expand the use of this framework to other types of risk as well, since opportunities may arise to lessen the effects of a risk rather than prevent it entirely. Mitigation should not be ignored, even if prevention is out of the organization's control.

- What can be done in advance of a disruptive event to lessen the impact of its effects?
- Can clearance prioritization take into account which areas disasters are likely to impact?
- Can important buildings and equipment be better protected from damage?
- How can we prevent loss of data/ensure uninterrupted access to data during a crisis?

Preparedness. Preparedness requires managers to consider what is needed to guarantee that the organization is prepared for response to a disruptive event. Preparations could involve information, plans, resources, tools, training or people.

- Who are the existing internal organizations for emergency response? Who is the focal point? Is ERW response represented?
- Do those coordinating the response know of PM/WRA and its implementing partners as a resource for explosive hazards that may be encountered in the field?
- What international organizations are likely to be involved in the response? Who are the counterparts in neighboring countries?
- Would you know what to do in a disaster situation? Would staff know what is expected of them?
- What is the current clearance strategy, and how is it (or would it be) impacted?
- What is the disaster risk profile of the country (if available), and where can this information be found?

Response. Response is closely linked to preparedness and requires the manager to consider how to ensure the organization is capable of effectively responding to a disruptive event.

- What lines of communication will be used?
- How can you avoid panic among the general population,

“... we cannot wait until a crisis happens to figure out what we know or don’t know and what to do.”

as well as prevent/dispel misinformation or rumor?

- How would an emergency-clearance plan take shape? What mechanisms exist? What is required of assets and resources in the country?
- What information/resources are needed to develop/execute the plan? (e.g., satellite images, community input, etc.)
- What happens if the affected area is in dispute? Is there a neutral third party that needs to be called in?

Recovery. The recovery phase is the process of getting back to normal. In this stage the manager should consider what is needed to shift from the emergency-response phase back to normal operations.

- How can you communicate to the public that emergency-response operations are complete?
- Will ad hoc committees/networks or other groups continue to meet/communicate or disband?
- How can you ensure continued planning for the next disruptive event?

Best Practices and Lessons Learned for Planning

The overarching lesson that came out of this research was that we cannot wait until a crisis happens to figure out what we know or don’t know and what to do. Planning ahead for disruptions of any magnitude will help the CWD community better address such issues as they arise. Proaction rather than reaction is imperative when managing risks. With regard to the suggested framework, managers should map out a plan that addresses all four phases, translating the answers to the questions previously discussed or posed into specific protocols and actions to take. Managers need to ensure they have considered all aspects of the organization’s operations (personnel, finances, communications, etc.). Also, keeping the plan updated is important. It should not be a static document to develop and then put on a shelf. Managers should review the plan annually or at the start of each new project to guarantee the information is kept up to date.

Our research in examining programs that previously dealt with natural disasters in ERW-contaminated areas brought to light some specific best practices and lessons learned in each of the four areas of the framework, listed below.

In regards to **mitigation**,

- Back up data off-site.
- Make sure data is not just recorded on paper.
- Determine if buildings can withstand a natural disaster, and identify measures to fortify them.
- Have an alternate site in mind as an operations base if structures are damaged.
- Consider prioritizing clearance of land more prone to disasters. Overlay suspected hazardous area maps with those of areas impacted in the past by disasters.

Concerning **preparedness**,

- Identify existing organizations/points of contact for emergency response (national and international levels).
- Become familiar with national laws on disaster response, and any existing national or local emergency plans.
- Understand the resources available for a disaster-response effort (within and outside the organization). Understand local capabilities and challenges or gaps.
- Consider what risk-management strategies could be employed—have a plan in place.
- Train staff and educate those likely to be involved in the response on how your organization can help.
- Consider running simulations to practice for an actual disaster situation (similar to practicing for other emergencies, such as injury in the field).

In relation to **response**,

- Communication and coordination are imperative to successful response with different organizations, international actors and other countries affected.
- Utilize your resources—existing infrastructure, mechanisms and equipment (e.g., schools, community-liaison teams) can gather and disseminate information.
- Know how to request assistance from donors (e.g., PM/WRA provides assistance through its Quick Reaction Force) and what their role is likely to be.
- Use available technologies to assist (e.g., satellite images, drones).
- Ensure donors are aware of how your resources may need to shift to aid in the response.
- Know where you can go to obtain the information you need.
- Write a sample emergency-clearance plan.

Regarding **recovery**,

- Develop a transition plan for gradually moving resources (people, assets) not needed for response back to regular operations.

- Ensure communication occurs as necessary with the public, media, etc., so all are aware that emergency response is complete.
- Assess what worked and didn't work with management plans for disruptive events.
- Ensure lessons learned from the other phases are incorporated into future plans and protocols.

Conclusion

Although this article looked at risk through the lens of disaster management, the framework described can be used in other risk situations encountered by the CWD community. Hopefully this work will encourage managers to think about issues of risk and potential disruptions to their operations. By thinking about these issues, organizations can better address them. Equally important is that the community openly discusses successes and failures from these experiences as well as shares experiences with others to increase general knowledge and improve future efforts.

See endnotes page 66

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> "Equally important is that the community openly discusses successes and failures from these experiences as well as share experiences with others to increase general knowledge and improve future efforts."

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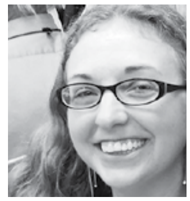

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Field Notes

An Overview of Mozambique's Mine-free District Process

by Antonio Belchior Vaz Martíns [National Demining Institute of Mozambique]
and Hans Risser [United Nations Development Programme, Mozambique]

In the 1990s, Mozambique ranked among countries such as Afghanistan, Angola, Bosnia and Herzegovina, Cambodia, and Iraq as one of the most mine-contaminated countries in the world. At the time, experts estimated that clearing all landmines in Mozambique would take 50 to 100 years. Landmines were widely used by all sides during the conflicts that ravaged Mozambique from the mid-1960s until 1992. These nuisance minefields usually consisted of small numbers of mines in seemingly random or undefined areas mostly around paths, wells and rural infrastructure. Large-pattern minefields tended to be the exception rather than the norm in Mozambique. Given the widespread use of landmines and poorly defined minefields, how did the government and international partners identify and clear all mined areas in accordance with the country's obligations under the *Anti-personnel Mine Ban Convention* (APMBC)?

Article 5 Obligations

Article 5 of the APMBC states that "each State Party shall make every effort to identify all areas under its jurisdiction or control in which anti-personnel mines are known or suspected to be emplaced" and "to destroy or ensure the destruction of all anti-personnel mines in mined areas under its jurisdiction or control, as soon as possible."[1] However, as with most laws, this text has been interpreted in several ways, leading some to believe the aim of the APMBC was to achieve a **mine-free, mine-impact free** or **mine-safe** status. Yet, none of these previous terms actually appear in the text of the convention. Seeking to clarify the interpretation of Article 5's intent, the state parties to the convention agreed that "the Convention does not contain language that would require each State Party to search every square meter of its territory to find mines."[2] However, Article 5 does require that state parties **make every effort** to identify all mined areas under their jurisdiction or control, and clear those areas without delay.

In a country such as Mozambique, where mine contamination was widespread and not in well-defined areas, what qualifies as **every effort required to identify all known areas**? The process of identifying all known confirmed and suspected hazard areas (SHAs) requires transparency and accountability to ensure that a reasonable effort is made to identify all areas, without aiming to clear every square meter of territory. In Mozambique's case, the answer to this dilemma and the question of how much effort is enough became known as the Mine-free District (MFD) Process.

Mine-free District Process

From 1993 to 2007, The HALO Trust was the lead agency responsible for demining the four northern provinces of Mozambique (i.e. Cabo Delgado, Niassa, Numpula and Zambezia). As HALO approached the end of its task list in 2004, it developed a district-wide survey concept, creating the necessary conditions for an end state and documentation as evidence that no further known mined areas existed in the districts within the four northern provinces. HALO called this district-wide assessment the Mine Impact Free District (MIFD) Survey, a comprehensive survey designed to be implemented toward the end of a demining operator's engagement in a country or geographical area.[3]

The MIFD survey required survey teams to visit every community within the northern provinces to interview a cross section of the people who lived there and determine if they knew of any remaining mines or other explosive remnants of war (ERW) threats. Any SHAs identified by the

"... what qualifies as every effort required to identify all known areas? "

Local community leaders in Mozambique participate in a Mine Free District Survey.
Photo courtesy of Antonio Belchior Vaz Martins, NDI.

communities required further technical survey and possibly clearance if the presence of mines or unexploded ordnance (UXO) was confirmed. In each district, at both the beginning and end of the process, district authorities were briefed on the findings. As a final step in the process, each community leader and district official accompanying the HALO teams signed a report to acknowledge that as far as they were aware there were no more known mined areas in their respective districts or communities. All reports were carefully archived in both hard and soft formats. The results of the MIFD surveys were shared with the National Demining Institute (NDI) for their consideration and liaison with other governmental bodies.[4] According to the report submitted to the NDI, the MIFD survey teams visited 6,395 communities and interviewed 401,007 people in the four northern provinces. Through the MIFD survey, 74 previously unknown SHAs were identified. HALO conducted technical survey and clearance in these 74 areas discovering and destroying a further 176 mines.[5]

NDI recognized the MIFD survey concept as a useful means for operators to exert a reasonable amount of effort to identify all possible hazardous areas in a district. However, while the HALO Trust's MIFD survey standard operating procedures (SOPs) became the SOPs outlining the responsibilities of the humanitarian demining operators in the process, NDI recognized that the local government, district government and provincial governments also needed to be formally brought into the process to ensure that the approach could become more accountable and comprehensive.

The MFD Process adopted by the government became an integral part of its National Mine Action Plan and the district-by-district approach that the government used to ensure all known SHAs in a district were completed before operators moved on to another district or area of operations. The government defined the term 'mine free' as the absence of any known mined areas or SHAs. In Mozambique, the term 'mine free' therefore does not rule out the possibility of unknown areas or even unknown landmines or other ERW.[6] The MFD Process became a means to ensure the implementation of Article 5 obligations in Mozambique while recognizing the need to improve the visibility, transparency and recording of demining results in the country.

Implementation of the Mine-free District Process

Given this framework, the government established six main objectives for the MFD Process:

- First, ensure the beneficiary communities and the government structures at provincial and subordinate district levels were satisfied and confident in the demining operators' work due to the communities' and governments' direct involvement in the process of evaluating and validating the survey and clearance operations' results.
- Second, through the MFD Process, the government hoped to eliminate any SHAs in the districts where clearance operations were completed or nearing completion.
- Third, the MFD Process aimed to formalize the official process for delivering completion reports on demined areas to the government structures at the provincial, district and local community levels.
- Fourth, by formally declaring completed districts mine free, the government promoted investment and implementation of socioeconomic development projects.
- Fifth, by taking a district-by-district approach, the government focused on demining efforts in districts still facing problems with landmines and other ERW while clearly defining those districts where the problem was resolved.
- Sixth, the government also aimed to establish sustainable mechanisms, in addition to NDI, for monitoring the national mine action program at the provincial, district and local community levels.

The MFD Process consisted of four primary steps:

- First, complete demining operations in all confirmed hazardous areas (CHA) and SHAs at the district level, and formally hand over those same areas to local communities for development and socioeconomic activities.
- Second, evaluate all affected communities at the district level to confirm the community's level of satisfaction with the results of demining operations, including confirming and documenting that, to the best of their knowledge, no additional SHAs remain in their local communities.
- Third, ensure the provincial government receives all necessary information on those districts within the province that qualified as mine free.
- Finally, hold an official handover ceremony in which the demining-operation completion reports, maps and other pertinent data on all demining in the districts are given to the governmental authorities of the mine-free classified districts.

The primary tools utilized in the MFD Process include NDI's guidelines for the classification of mine-free districts; demining reports—i.e., survey, area reduction, demining completion and quality-assurance (QA) reports—NDI's procedures and SOPs for QA in Mozambique; the complete list of all administrative divisions in Mozambique; as well as the national mine action standards.

In order to implement the MFD Process, roles and responsibilities were defined for four main actors or groups of actors at various administrative levels:

- NDI and its QA teams represented the national authority.
- The demining organizations were the primary implementers at local and district levels.
- The local government represented by the community authorities, town or settlement leaders; local police commanders; and the heads of local administrative posts were the primary beneficiary groups at the local level.
- Government administrators represented the provincial and district levels.

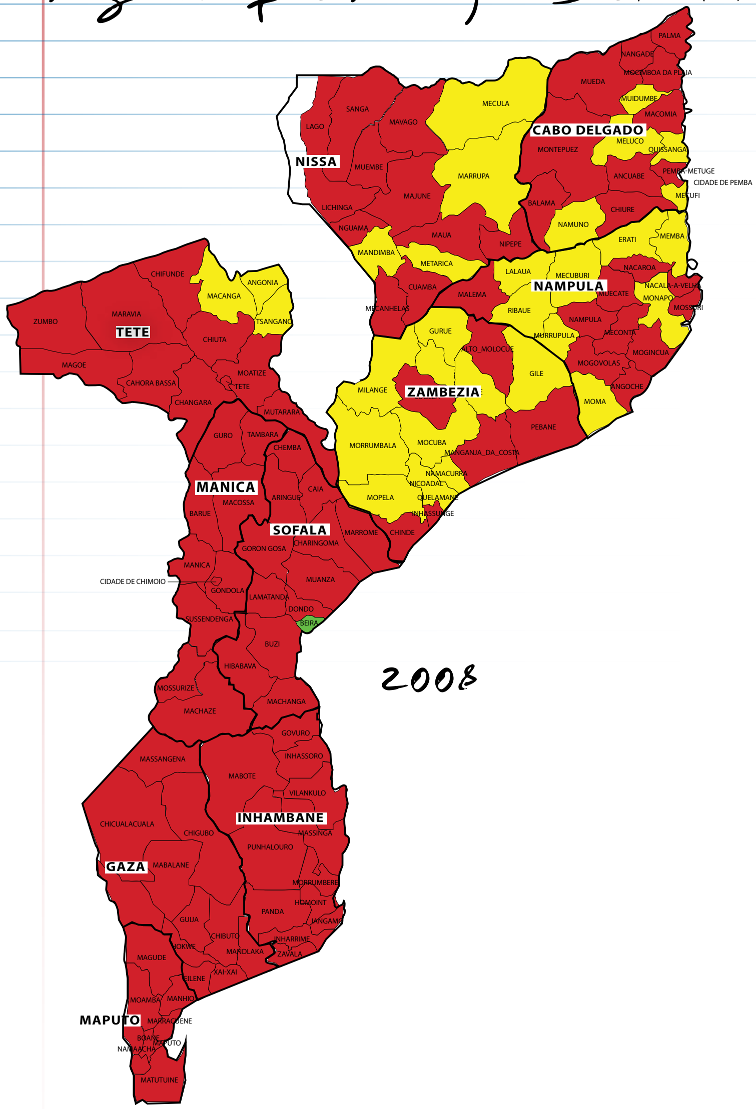
The various actors' responsibilities and actions are outlined here:

NDI and QA teams

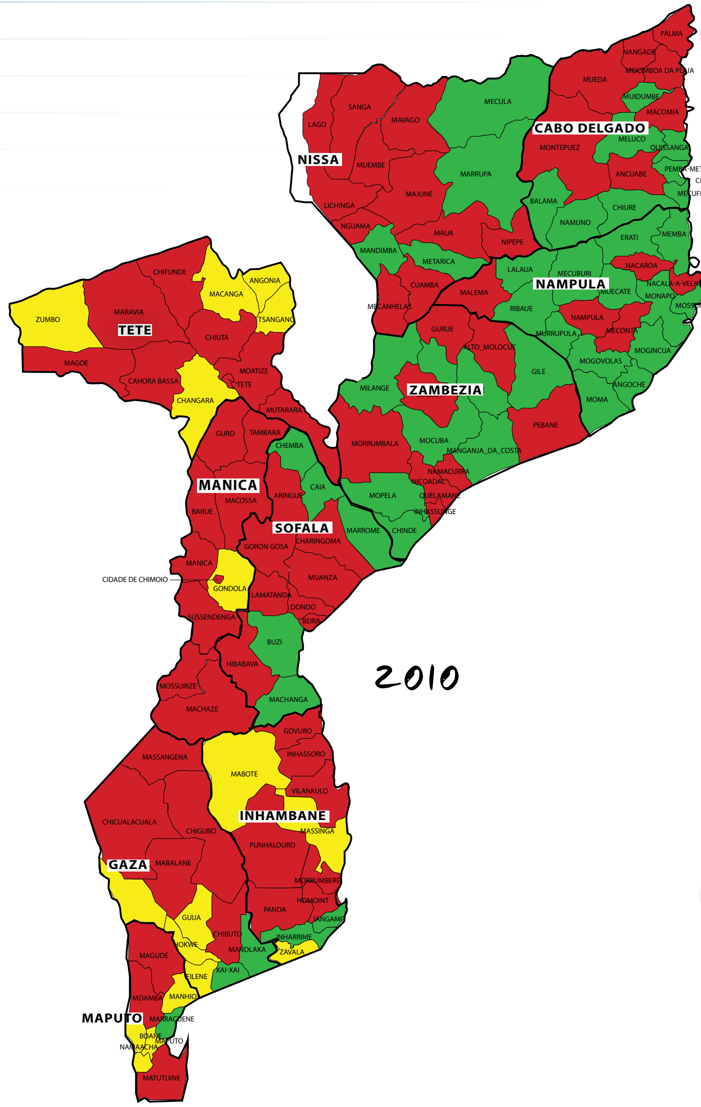
- Coordinated, monitored and supervised the MFD Process and classification of districts as mine free.
- Validated the results of the demining operations and assured handover of demined areas to communities

"The government of Mozambique is under no illusions that a residual risk remains of finding previously unknown ERW or even landmines..."

Mozambique's Mine-free District Process



Mozambique, **2008**
Yellow: District without landmine contamination
Red: District with landmine contamination
All maps courtesy of IMSMA/CISR.



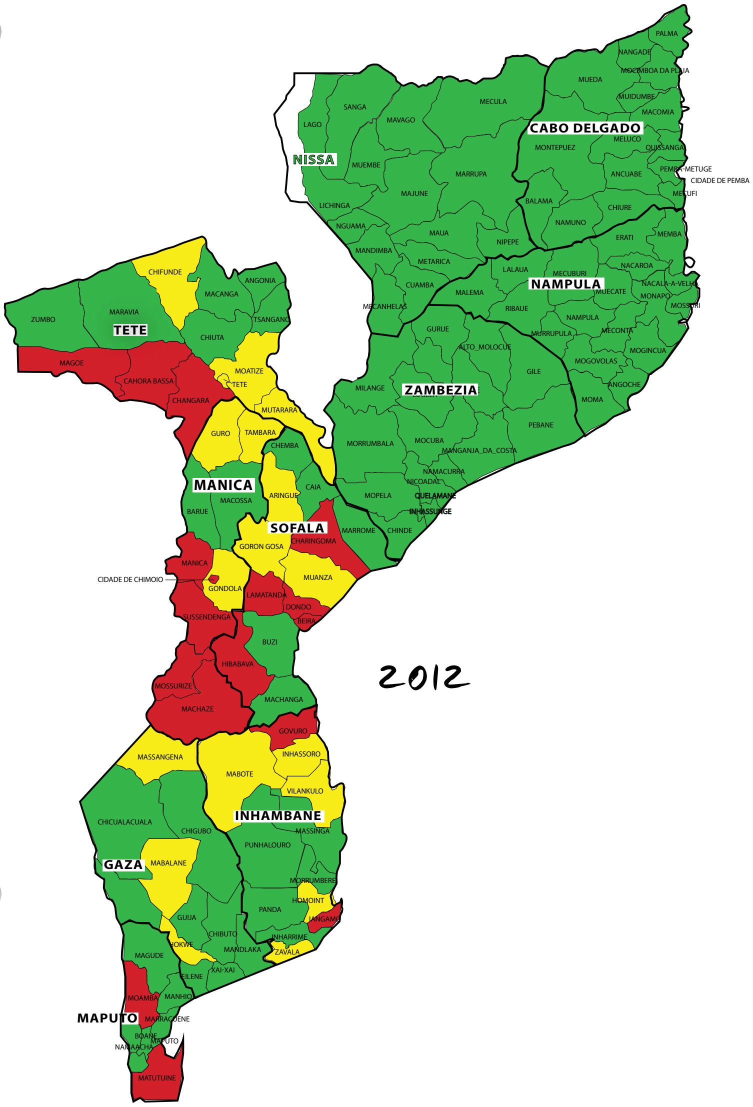
Mozambique, **2010**
Green: District free of mines
Yellow: District in final phase of demining activity
Red: District with hazardous areas to be cleared following year

and government structures at the district level to initiate socioeconomic activities.

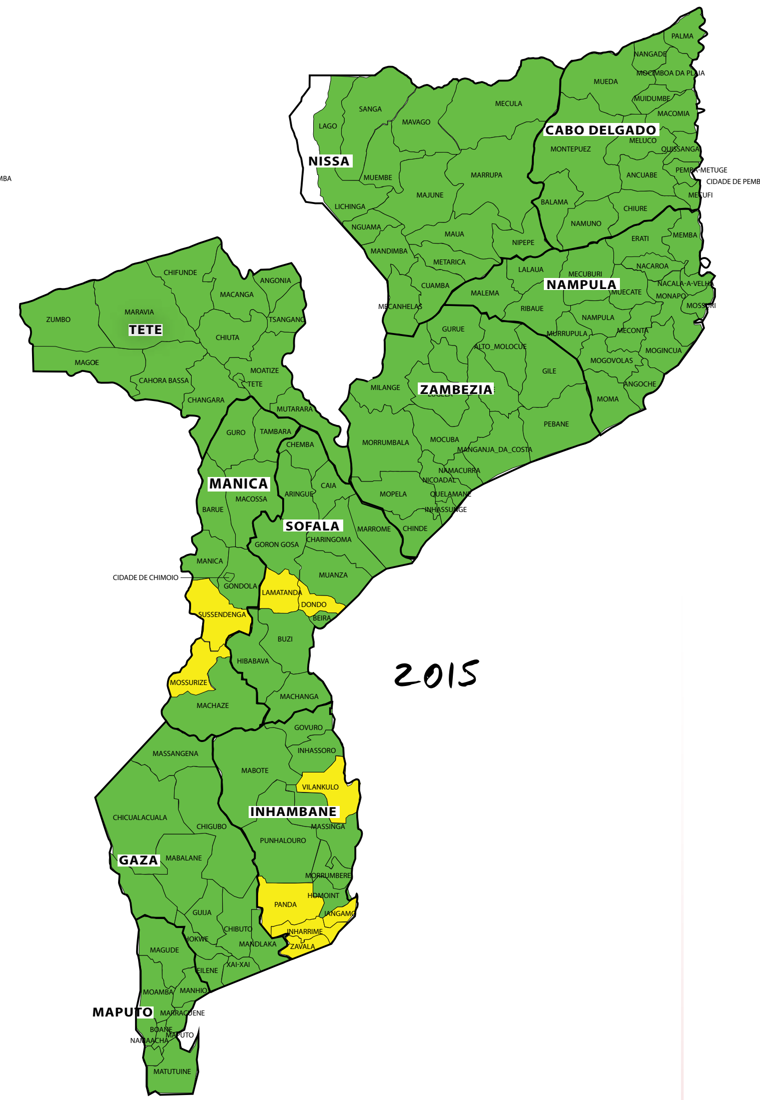
- Provided information to the provincial governments on the districts that can be formally classified as mine free.
- Produced a final report on the conclusion of all demining operations in the districts classified as mine free.
- Coordinated and organized public ceremonies marking the official delivery of all demining completion reports to the government structures of the districts classified as mine free.

The humanitarian demining operators

- Conducted demining operations on all assigned areas at the district level and ensured that survey teams visited all communities (including formal and informal settlements). The demining operator's survey teams interviewed the local communities to determine and record the presence or absence of any suspected areas in their vicinity.
- Provided all reports on demining operations conducted in the districts to NDI, thus reinforcing what national mine action standards already require.
- Supported and participated jointly with NDI QA teams in the formal handover of all cleared areas to the local communities and government structures at the district level.
- Conducted the official handover in coordination with



Mozambique, **2012**
Green: District free of mines
Yellow: District in final phase of demining activity
Red: District with hazardous area to be cleared following year



Mozambique, January **2015**
Green: District free of mines
Yellow: District nearing completion

NDI of all completion reports for demining operations in the district to government authorities in districts classified as mine free.

The local community authorities, district governments and provincial government through its appointed representatives

- Supported data collection on CHAs and SHAs in their respective areas.
- Participated in the evaluation and validation of demining operations conducted by NDI and demining operators.
- Shared responsibility for ensuring that communities in the districts classified as mine free were satisfied with the results of the demining operations.
- Supported NDI and demining operators in organizing the official ceremonies for the handover of demining completion reports to the government structures of the mine-free districts.
- Archived and filed (for public and other local government institutions to consult in the future) all of the comprehensive conclusion report of demining operations in the district prepared by NDI, and the completion reports from all demining operators in the district.
- Shared information on the results and impact of demining operations in their respective areas among government structures and development and cooperation partners, as well as other relevant authorities at national and international levels.

An NDI QA officer checks coordinates of a survey report for a suspected hazardous area.
Photo courtesy of Antonio Belchior Vaz Martíns, NDI.

Benefits and Results of the MFD Process in Mozambique

Implementation of the MFD Process in Mozambique resulted in clear advantages and benefits to the overall national mine action program in Mozambique. The process allowed better management of the overall mine-contamination problem in Mozambique with progress tracked clearly in the status of each individual district. In the absence of written information from former combatants, documentary evidence or military maps with data on mine contamination, the local communities became the most reliable source for information on mine contamination. Moreover, many former combatants with relevant information on mine contamination could be found and interviewed in the local communities. Thus, the interaction and survey process of all local communities within a district provided a means for the government and national mine action program to exert all reasonable effort to identify and clear all known mined areas in a manner meeting the obligations of the APMBC's Article 5. Another clear advantage of the MFD Process was the documentation generated with formal signatures required from NDI QA teams, local community leaders, police commanders and demining operators. The paper trail generated by the process allows for a transparent and accountable manner of ensuring that all known mined areas in each district were identified and cleared, removing the need to search every square meter of its territory.

While the process itself may be misunderstood due to its use of the term mine free, the government clearly defined the term in its national context: A mine-free district no longer contains any known CHAs or SHAs, and is supported by documentation with signatures from each community in the district that they are satisfied with the results. The government of Mozambique is under no illusions that a residual risk remains of finding previously unknown ERW or even landmines, and is taking appropriate action to prepare a sustainable national capacity for such an eventuality. The ultimate success of the process is Mozambique's formal declaration in 2015 of compliance with Article 5 of the APMBC. Hopefully mine-affected states in similar situations will find these lessons learned from Mozambique useful.

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Field Notes

Transition and National Capacity After Article 5 Compliance

by Hans Risser [United Nations Development Programme, Mozambique]
and Christian Ruge [Norwegian Peacebuilding Resource]

In June 2014, State Parties to the *Anti-Personnel Mine Ban Convention* (APMBC) met in Maputo, Mozambique, for the 3rd Review Conference of the APMBC, fifteen years after its entry into force. As the review conference approached, State Parties faced a growing call from civil society and some State Parties to commit to complete all obligations in the treaty as rapidly as possible. The majority of State Parties have already completed their APBMC obligations to destroy stockpiles of anti-personnel (AP) mines. However, surveying and clearing all known mined areas in a state's territory in accordance with obligations under Article 5 of the treaty is no easy task. Considerable progress has been made, and some states with moderate to heavy contamination are moving toward an end state. In 2015, Mozambique completed demining of all known minefields after approximately 20 years of survey and mine clearance efforts.[1]

As more states approach completion, governments and mine action stakeholders should consider certain issues that arise as a consequence. Completion of Article 5 obligations is a major achievement for mine-affected countries but does not mark the final conclusion of clearance in their country.

As leader of the Third Review Conference, Mozambique facilitated a discussion during the Review Conference and at a subsequent regional meeting on how to prepare for the transition from Article 5 clearance to longer-term operations that address residual explosive remnants of war (ERW). The objective was to identify policy recommendations that may be considered by States Parties to the convention.

The discussion focused on the following questions:

- How do national authorities ensure optimal productivity up until the completion date?
- How can national authorities assist deminers in finding other employment opportunities following the completion of all demining tasks?
- How should national authorities prepare their mine action coordination structures and demining staff for the post-completion situation?
- How do national authorities retain key operational personnel throughout closing and quality control operations and ensure proper documentation of efforts is available for future use?

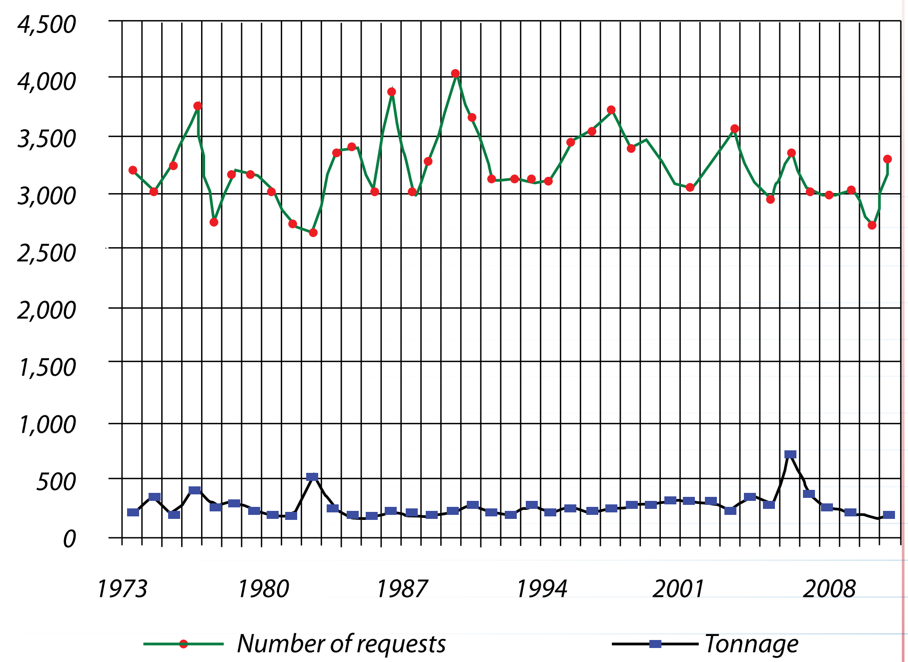

Figure 1. Belgium: Annual ERW response
All figures courtesy of GICHD's Management of Residual ERW Project.

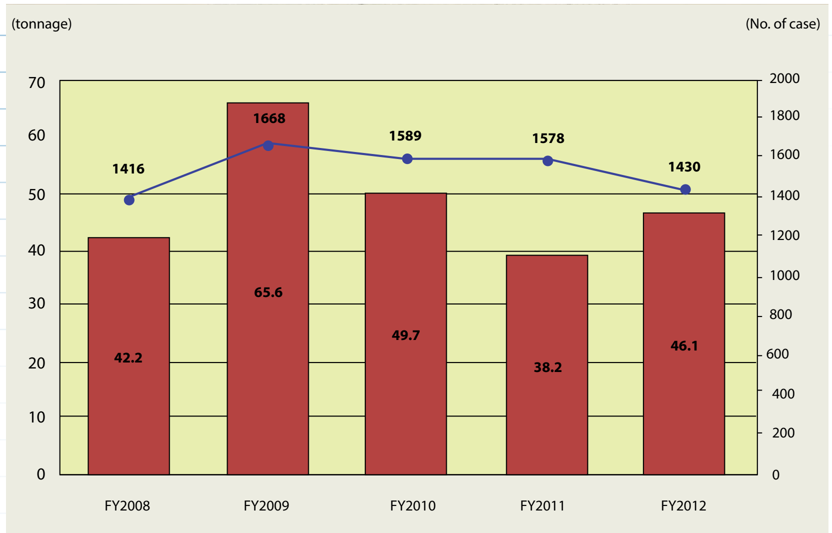

Figure 2. Japan: Annual ERW Response.

- After Article 5 completion, how will national authorities identify and manage the hazards and risks posed by residual ERW?
- After Article 5 completion, what will happen to the national mine action database and will clearance records be utilized and updated to manage information on any residual ERW accidents and clearance activities?

This article reviews some of the challenges that State Parties to the APMBC face in completing their obligations to clear all known mined areas, as well as what can be done with the national mine action capacity after completion and what is needed in the future to respond to the inevitable residual ERW contamination. The case of Mozambique provides an example of how State Parties and their international partners can prepare for the challenges of completion and plan for the transition of their national mine action capacity.

ERW Contamination: Not Always a Humanitarian Crisis

Most states that have experienced sustained armed conflict over the last century will have some sort of explosive ordnance problem that needs to be addressed in a rational, transparent and systematic manner. Experience from Europe and other parts of the world that still contain areas contaminated with explosive remnants of war (ERW) dating back to both World War I and World War II indicates that this is a problem that requires a sustainable, long-term national response.

Immediately after a conflict, ERW contamination poses a serious humanitarian problem and hinders recovery efforts. In such cases, proactive survey and clearance operations led or assisted by international partners are necessary. Despite the best and most thorough clearance operations, a small residual risk will remain, and a missed mine, piece of unexploded ordnance (UXO) or previously unknown suspected hazardous areas (SHA) could be identified. However minor the risk, residual ERW contamination constitutes a certain security and safety risk to the population, and it may hamper and significantly increase the cost of infrastructure development. Explosive ordnance may also be a source of explosive materials for groups and individuals involved in criminal activities. It is thus a situation that needs to be addressed by the state, as part of its responsibility to uphold the law, provide security and facilitate development. A sustainable, national capacity is required to identify the risk from any residual ERW and manage the hazards posed to the population.

In order to prepare for this, many current mine-affected states need to consider how to transition from having a dedicated mine action center to establishing a sustainable explosive ordnance disposal (EOD) capacity.

Addressing Residual ERW Problems

Addressing long-term ERW contamination requires a different approach and capacity than addressing mined areas. Mine clearance under Article 5 is essentially a proactive process involving relatively large numbers of survey and demining teams that are often supported by international technical advisors and financial assistance. Addressing the long-term ERW problem in most states would entail a reactive process involving a smaller, more sustainable national capacity, where threats are identified by civilians and cleared by personnel. The process requires different timelines as opposed to the five- to 10-year cycles provided by the APMBC. With little or no realistic baseline against which progress may be assessed, it is typically impossible to define a definite endpoint.

Most states need a robust, reactive system for reporting, recording and responding to explosive ordnance that is designed to function in a sustainable manner in the long term. However, the expertise necessary to set up and maintain a reporting and recording system that is trusted by the general public and all relevant stakeholders differs from the expertise necessary to identify and render safe an unexploded bomb or grenade. Governments need to identify what role, if any, current mine action coordination structures should have in the transition and post-completion scenarios. Preparing for the transition to a post-completion scenario will ensure State Parties have a sustainable capacity to report and address the discovery of any previously unknown mined areas that may eventually be discovered after reporting compliance with Article 5.

Preparing for Completion and Transition

National authorities approaching completion of Article 5 obligations would benefit from simultaneously preparing for both completion and transition within the same strategic framework. In doing so, one could look at the Article 5 deadline as an important milestone or transition point in a long-term exercise that aims at maintaining a rational and effective response to the problem of explosive ordnance.

Achieving compliance is a major accomplishment in itself. However, maintaining the motivation and technical capacity required to ensure the demining is completed within the timeline set by the country's Article 5 obligations is one of the challenges. Previous experience shows that productivity rates among deminers tend to decrease as they approach the end of demining operations. Knowing that they are working toward their own unemployment, deminers may be tempted to extend demining tasks for as long as possible for their own economic self-preservation. The situation may be further complicated when mine-affected communities benefit economically from the presence of demining teams (e.g., employment of local people or the provision of services to demining teams) creating an incentive to report clear areas as having mine contamination. Designing incentives and rewards to keep deminers and quality assurance inspectors motivated, honest and productive until the end is an important issue to ensure demining does not fall behind schedule. Restructuring and retraining programs that assist deminers' transition to new employment opportunities following the completion of demining tasks could also be a means to keep deminers motivated.

In the case of Mozambique, deminers maintained high morale and remained motivated through organized completion ceremonies for each province, with special recognition given to the deminers involved. The government also encouraged demining operators to incorporate retraining and education programs as well as severance packages for the deminers into the operator's annual budget. Critically, the Mozambique government also discussed the situation with donors and encouraged development partners to support deminers' retraining and education.

Mine affected states could benefit from reviewing their current resources, such as their technical staff, and determining how said resources could be used to support long-term efforts. Considering how national and international actors have invested in building national mine action coordination structures, it is worth understanding how these capacities can be repurposed for future use by the national authorities.

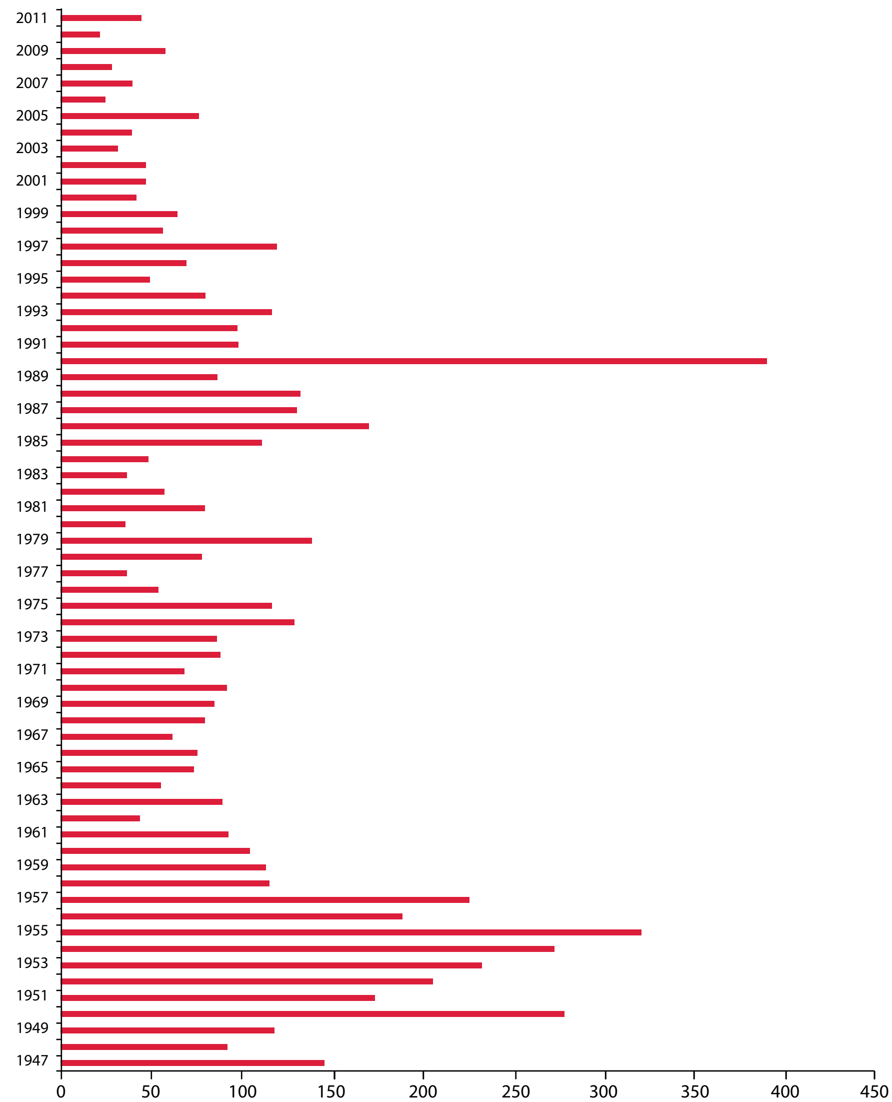

Figure 3. Berlin: Annual disposal of unexploded ordnance in metric tons 1947-2011.

By creating a viable transition plan for mine action structures before all demining tasks are completed, national authorities can retain skilled employees and national capacities.

When transitioning from large-scale, internationally-supported demining capacities to smaller, nationally-led, post-completion capacities, national mine action authorities should review and map their capacities and the roles of their mine action centers. To use these capacities effectively, national authorities should compare the abilities of their centers to national legislation on disaster management and the control of the civilian explosives industry (i.e., the production, transportation, sale, storage and licensing of commercial operators). Maintaining records of clearance operations will be integral for future construction projects as well as clarifying any liability issues in case of future accidents. For many mine-affected countries, demining organizations in the field respond to regular reports from civilians for EOD spot tasks to remove explosive items as part of their normal mine action duties. Following Article 5 completion, a sustainable national capacity (e.g., police, military or civilian protection forces) should be trained to assume this role and the civilian population informed on how to report suspicious items.

Trainers from the Mozambique National Demining Institute and U.S. AFRICOM conduct EOD training in Inhambane Province, Mozambique (September 2015).
Photo courtesy of the Mozambique National Demining Institute

As an example, a transition plan for post-completion national capacity may include the need to:

1. Train police, military or civilian protection forces to conduct small, EOD spot tasks and accident investigations as an emergency response for public safety
2. Maintain a national database with information publically available for liability issues and future construction projects that may require digging below the depth of clearance established by the national mine action standard in previously contaminated areas
3. Quality assurance or quality control in EOD or mine action related activities to control the implementation of national legislation on the production, transport and use of explosives in the civilian commercial sector
4. Licensing and contracting authority for either commercial entities or nongovernmental organizations to conduct future EOD spot tasks as required for residual ERW or clearance operations in a larger area if previously unknown mined areas are discovered
5. Provide advisory services to private investors and planning units or project management units in the ministries on how to arrange for any risk reduction and verification services (from local/regional firms or NGOs) that might be required for future private or public development projects

In Mozambique, the aforementioned issues were considered. With the assistance of the Geneva International Centre for Humanitarian Demining (GICHD) and the United Nations Development Programme (UNDP), a transitional strategy was drafted for the management of ERW. This plan called for the transition of the Mozambique Mine Action Centre into a training facility, which will be used to equip and train police officers in basic EOD in each province. The national database and all mine clearance records will be handed over to the national authority that manages the land where it will be maintained and used by anyone seeking to build or develop the area.

Starting in 2014, the National Demining Institute partnered with the U.S. military's AFRICOM to train and equip a team of Mozambican trainers, who would later train provincial police officers in ERW identification, risk analysis and basic level 1 explosive ordnance disposal. AFRICOM and the Mozambique National Demining Institute developed a core curriculum and began training police officers, with an aim to have a small team of police trained and equipped in each province to manage residual ERW after the demining operators completed the survey and clearance of all known mined areas. With the support of AFRICOM and UNDP, trainers from the National Demining Institute successfully trained and equipped more than 124 police officers across all of the country's 10 provinces by the end of 2015.

Donors to mine clearance efforts may also benefit from considering how to structure their support in a way that facilitates efficient and effective resource use while retaining the national capacities established with their support. In the case of Mozambique, the National Demining Institute and international demining operators began discussing transition plans and retraining of deminers early on. This focus on the transition process secured the support of some donors and the critical funding for these long-term transitional efforts.

Structuring international support for this transition period may address claims by previously mine-affected State Parties that financial assistance to address UXO and ERW issues stopped immediately after declaration of Article 5 compliance. While Article 5 compliance may signal the end of active demining operations, international support and assistance can and should be used for the establishment of a sustainable national capacity that shifts its focus to other ERW priorities such as a response to residual UXO, explosive storage stockpile management or the clearance of other areas contaminated by ERW other than landmines.

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Elements of this paper were originally introduced as a discussion paper to the Third Review Conference of the APMBC held in Maputo in 2014.

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Field Notes

TIRAMISU Final Technology Demonstration at SEDEE-DOVO

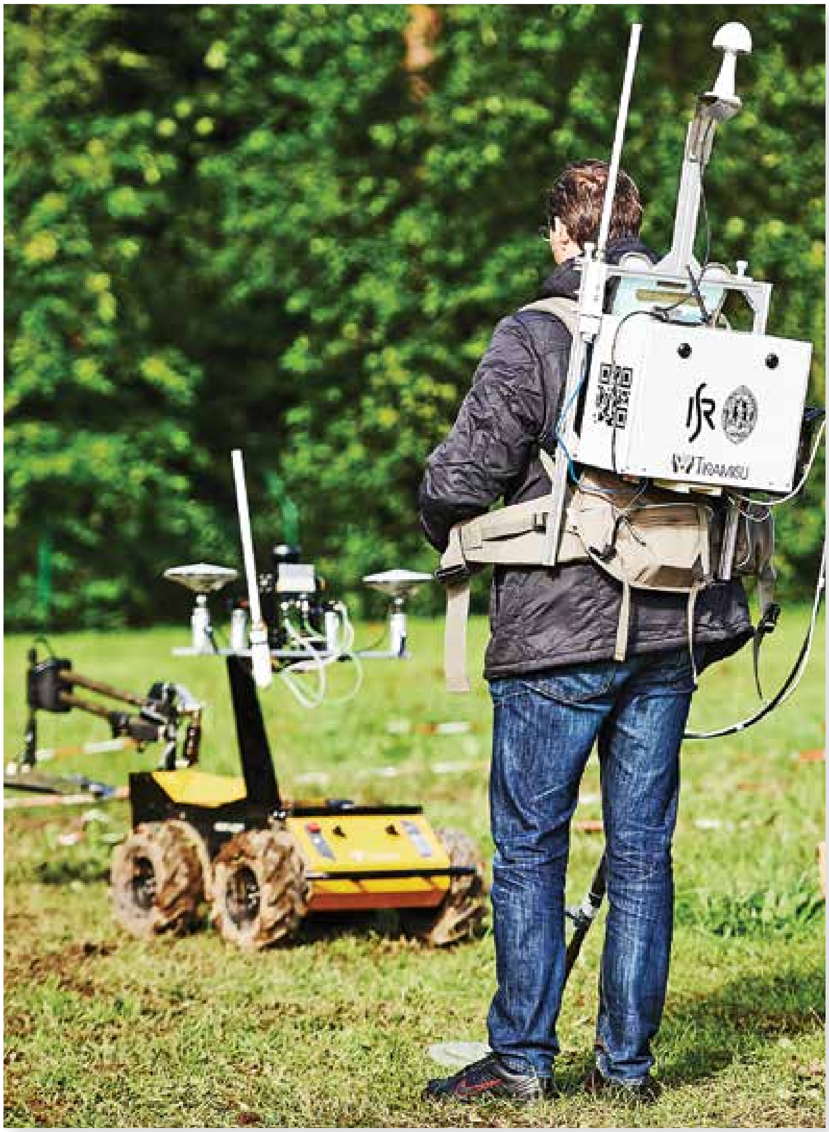
By Yann Yvinec, Ph.D., Vinciane Lacroix, Ph.D. and Yvan Baudoin, Ph.D. [Royal Military Academy of Belgium]

A few of the products demonstrated include the TIRAMISU drone, which provides 3D mapping capabilities, and the TIRAMISAR (in the background on the right), a side-looking imaging sensor with ground penetrating radar.

On 24 September 2015, and in the presence of Her Royal Highness Princess Astrid of Belgium, the Royal Military Academy of Belgium (RMA) organized a demonstration for mine action tools in Meerdael, Belgium. At the Belgian EOD battalion premises of SEDEE-DOVO, RMA presented technology developed under the TIRAMISU project, which was co-funded by the European Union and coordinated by RMA.[1] Designed by twenty-six different organizations, the tools covered multiple elements of mine action, including survey, operation and validation, information management, mine risk education (MRE), close-in-detection, and personnel protective equipment (PPE). Organizers held inside and outside demonstrations as well as discussions of the tools developed throughout the four-year project.

Outdoor demonstrations involved several pieces of mechanical equipment with mounted detectors, including a remotely-controlled vehicle with a multi-channel metal detector; an agriculture tractor-based vehicle with a ground penetrating radar and blast resistant wheels; a small autonomous robot with a rotating metal detector; and a vehicle-mounted, side-looking radar.[2,3]

Organizers also presented geospatial tools based on open-source information and earth-observational data. Visibility and trafficability analyses demonstrated utility for the areas of battle reconstruction, vulnerability estimation and mine action campaign planning. A prioritization tool was demonstrated using a case study from Cambodia, while a case study from Croatia demonstrated how satellite data, airborne surveys and drones can assist in determining the presence or absence of mine indicators.



The arm of the remotely operated Semi-autonomous Demining Robot Husky-ISR/UC carries a triple coil metal detector, and the robot carries a sensor payload composed of video cameras, a 3D laser range finder, an inertial measuring unit and a GPS receiver.

After floods struck Bosnia and Herzegovina in 2014, a drone capable of building a three-dimensional representation of terrain assisted with search and rescue operations, and was used to identify locations where floods could have displaced landmines.[4] This technology was demonstrated at SEDEE-DOVO. The combination of the three-dimensionally generated relief and aerial data was recognized as a valuable tool for surveyors, and a guide on "Geoinformation for demining" is available on the TIRAMISU website, listing products' availability and capabilities.[2]

Relating to data collection during surveys, SPINATOR developed a tablet application called TIRAMISU Information Management System (T-IMS), which ensures data are collected correctly with GPS coordinates and are easily compatible with other systems. Alternatively, proTime and DIALOGIS designed a set of communication boxes to create a Wi-Fi mesh where GPS coordinates and data can be transferred in the absence of an Internet connection. These boxes can be mounted on mobile equipment, together with a metal detector, in order to gather data and record its position.

The event demonstrated two methods for mine risk education (MRE). Snail Aid exhibited a modular and highly-adaptable theater play that is broadcast via radio and was evaluated in Algeria and Cambodia.[5] Additionally, the Institute of Mathematical Machines presented an electronic board game that teaches children MRE safety messages to mitigate the everyday dangers of landmines.

The Spanish National Research Council (CSIC) demonstrated new methods for training that involved the implementation of detectors and prodders for deminers as well as virtual reality applications for operators of remotely-controlled vehicles. The University of St. Andrews (U.K.) introduced an explosives detector vapor that can be used together with the Remote Explosive Scent Tracing (REST) survey method.

The Military Institute of Technical Engineering (WITI) showcased a blast-resistant container designed to transport hazardous items to disposal areas. The container was tested extensively to evaluate its resistance in case of an unwanted explosion. WITI also demonstrated new techniques to dispose of explosives that involved the physical destruction of the fuse using hexogen charges.

While most PPE is currently tested against several consecutive impacts, equipment can sustain far worse damage when multiple impacts occur simultaneously. To test equipment against this kind of threat, RMA designed a piece of equipment with three adjacent barrels that can shoot three projectiles almost simultaneously at a test object. Attendees had the opportunity to view a film depicting the triple-launcher at work in the RMA ballistic lab.

Haris Balta of the Belgian RMA prepares the Teodor V-Metal Detector D Array for a field demonstration.

Other fundamental research included the use of honey bees to detect explosives developed by the University of Zagreb (Croatia) and the Croatian Mine Action Centre (CROMAC) Centre for Testing, Development and Training (CTDT), and a smart prodder developed by the University of Catania (Italy) that can identify the type of material detected. Other developments include innovations in ground penetrating radar technology, metal detection and GIS mapping capabilities.

Conclusion

The objective of the TIRAMISU project is to provide the mine action community with a multi-functional toolbox that can assist in addressing the many issues related to humanitarian demining. Twenty-six partners collaborated over four years (starting in 2012) to build the best tools Europe can offer to make mine and unexploded ordnance clearance safer and more efficient.

For more detailed information on the technology featured at SEDEE-DOVO, please view the online version of this article at http://www.jmu.edu/cisr, or visit the TIRAMISU website at http://www.fp7-tiramisu.eu.

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R&D

Research and Development

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SMALL CALIBER DE-ARMERS: AN ANSWER TO EXPLOSIVE ACQUISITION PROBLEMS

by Harold S. Pearson [Development Technology Workshop]

Complete Mini De-Armer with de-bulleting kit, reloading kit and tool roll.
All graphics courtesy of author.

In many mine-affected countries, sourcing, transporting and reliably initiating explosives is one of the major obstacles for mine action operators. Consequently, finding a reliable method of destroying anti-personnel (AP) landmines and other explosive remnants of war (ERW) contamination that does not require the use of high explosives is of great interest to many in the industry.

While .50-caliber de-armers and disruptors are widely used in the world of explosive ordnance disposal (EOD), their use in landmine and unexploded ordnance (UXO) clearance is less common. Both de-armers and disruptors function by firing projectiles at ERW items. Whereas a de-armer uses a steel slug as the projectile, a disruptor uses the projectile motion of a water jet. These tools use de-bulleted and re-loaded cartridges fitted with electric matches that are loaded into a breech with the breech cap tightened down. A de-armer consists of a slug that is loaded into the threaded end of a barrel, which is then screwed onto a breech. Alternatively, a disruptor consists of a plastic slug that is loaded into the threaded end of a barrel, acting as a seal, as the barrel is screwed onto a breech. The disruptor is then positioned vertically, and water is poured into the barrel to within 10 mm of the top, which is then sealed with a close-fitting polystyrene plug.

De-armers and disruptors are positioned so that their barrels are within 25 mm of their targets. Both are initiated via an electric cable that is connected to a standard electronic blasting machine (i.e., an electric power source for initiating the detonation) that is a safe distance away as designated by the on-site EOD officer. The machine then sends a current to the electric match inside the cartridge, causing the cartridge to fire and propel the steel slug or water jet toward the target at a high velocity, de-arming or disrupting the firing chain, usually without initiating the main charge within the munitions or explosive device. It is the responsibility of the on-site EOD officer to decide whether the UXO can be moved safely, and whether the explosive charge can be removed for disposal.

Many operators find that in addition to their cost, the power cartridges used by these tools are often expensive and problematic to move due to restrictions on the transportation and importation of explosives. However, these challenges led The HALO Trust to pursue a collaborative project with Development Technology Workshop (DTW) to develop alternative clearance methods that could use locally sourced ammunition.

The DTW created a series of EOD tools and produced equipment for the following calibers: 7.62 x 39 mm, 12.7 x 108 mm, 14.5 x 114 mm (Russian) and 12.7 x 99 mm NATO. More than 80 of

Breakdown of the mini de-armer. From left to right: breech cap, de-bulleted 7.62 x 39 mm cartridge, breech, 14 mm steel slug, and barrel.

De-bulleted and re-loaded cartridges for three sizes of Mini De-Armers developed by DTW. From left to right: 7.62 x 39 mm, 12.7 x 108 mm (also available in 12.7 x 99 mm NATO), and 14.5 x 114 mm (Russian).

these tools were deployed in the field against live AP and anti-tank (AT) landmines and were used to remove fuzes from larger UXO safely for subsequent transport and disposal elsewhere. DTW also developed a rocket wrench (12.7 x 108 mm), nine of which were deployed. These use a pair of charges to unscrew the fuze from large UXO items (bombs and shells).

LOCALLY MANUFACTURED AMMUNITION

In the United Kingdom and United States, the high cost of a standard, commercial .50-caliber power cartridge (custom-made for de-armers) is one of the main deterrents to using disruptors for routine minefield demolitions. However, small-arms ammunition cartridges are widely available and much more affordable in many of the countries where demining takes place. DTW has developed **de-bulleting** kits that allow the use of ammunition manufactured or sourced in country, greatly reducing the costs of shipping and transportation.

These de-bulleting kits are supplied with each of their EOD de-armers/disruptors and require locally sourced ammunition and an electric match. The electric matches cost a mere 30 cents each, and an air courier can ship them as a normal package. Moreover, any standard electronic blasting machine can initiate these matches.

The de-bulleting process is straightforward and can be completed in five minutes. First, the bullet is pulled from the cartridge, and the propellant is poured into a container. Next, the percussion cap is struck and its brass housing removed. Then the electric match is inserted with its wires exiting through the hole where the percussion cap was originally. Thereafter the powder is poured back into the cartridge, which is crimped. Combined de-bulleting and crimping equipment is available and can be mounted on workshop benches to speed up the process considerably.[1]

HALO in Afghanistan now routinely uses the 12.7 x 108 mm disruptors to destroy AP mines in a role endorsed by the Mine Action Coordination Centre of Afghanistan. The use of de-bulleted cartridges avoids the need for demining personnel to transport explosives and detonators through areas with possible Taliban checkpoints, preventing the chance of diverting explosives into the wrong hands. Similarly, the devices were used in Cambodia to destroy mines along the Thai border, and negated the need to cause explosions in sensitive areas where the military and the local population prohibited the use of explosives.

PERFORMANCE: DEVELOPMENT OF THE MINI DE-ARMER

The 12.7 x 108 mm disruptor is an efficient tool, but engineers at DTW felt these cartridges were excessive when used to destroy plastic-bodied AP mines and de-arm other small ordnance such as 60 mm mortar bombs. The engineers believed they could harness sufficient power to destroy standard AP mines from a smaller cartridge. To this end, they experimented with the ubiquitous 7.62 x 39 mm round (the cartridge used by the AK-47).

Trial results on an indoor test range showed that a 14 mm steel slug driven by a de-bulleted 7.62 x 39 mm cartridge using the Mine De-Armer could penetrate a 4 mm mild steel witness plate.

A strike on a 60 mm mortar fuze with a 14 mm steel slug.

Figure 1 (left to right). Hard plastic 16 mm slug, 14 mm steel flat end, and chisel slug.

Figure 2. Mini De-Armer set up to destroy a PMN AP mine using the 16 mm, 2.4 g plastic slug. Note that a sandbag is placed on top of the tool before firing to dampen the recoil.

Figure 3. As a result of the strike, many parts of the mine were unrecoverable.

Figure 4. Mini De-Armer set up to destroy a PMN2 AP mine using a 14 mm, 27.2 g steel slug.

Figure 5. Result of the strike on the PMN2 with the 14mm steel slug.

Barrel length	Slug length	Slug diameter	Slug weight	Velocity	kj energy
70mm	16mm	16mm	2.4g	43m/s	0.0022kj
170mm	16mm	16mm	2.4g	54m/s	0.0034kj
250mm	16mm	16mm	2.4g	64m/s	0.0049kj

Table 1. K.E = ½mv2, where m = mass; v = velocity

Further experiments using a 16 mm hard plastic slug soon showed that the plastic slug was sufficiently energetic to destroy a range of plastic AP mines (including PMN, PMN2 and Type 72 mines). By using a plastic slug, engineers limit the amount of metal contamination to the surrounding area. Tests using a water projectile as described above were also conducted but showed that water added little extra value to the effect of the plastic slug in attacking AP mines. This contrasts with the larger 12.7 x 108 mm disruptor, which has proved very effective when used with the water projectile.

Trials of the 7.62 mm Mine De-Armer continue in Cambodia, but the system is capable of destroying most plastic AP mines. Field testing utilized a 14 mm diameter steel slug weighing 27.2 g with a barrel length of 135 mm and a 16 mm diameter hard plastic slug weighing 2.4 g with a barrel length of 175 mm. DTW engineers recognized that performance was dependent upon several factors:

1. Barrel length
2. Burn rate of the propellant, which depends on the grain size and is fixed by the reuse of existing propellant in this case
3. Projectile dimensions, including weight and diameter
4. Projectile fit to barrel; a tighter fit will result in a higher pressure buildup of propellant gasses and a higher velocity
5. Size of the charge, which is fixed by the size of the AK-47 cartridge.

Of these five factors, barrel length, projectile dimension and projectile fit were most easily modified, and hence offered the best opportunities for improving performance.

Based on the field test results, DTW decided to carry out ballistic testing using a chronograph on an indoor range in order to determine optimal dimensions for projectiles and barrels. The information in Table 1 relates specifically to the Mine De-Armer as part of DTW's research and development, and is not a guide for the energy required for the destruction of UXO. The plastic slug is made to be a tight fit and can be inserted by pushing it into the breech end of the barrel.

CONCLUSION

The results indicate the importance of barrel length when considering maximum output possibilities. Research and development will continue, but the current design of the Mine De-Armer destroys plastic-bodied AP mines and removes Bakelite fuzes from small mortar bombs. Furthermore, the current design is also suitable for use against improvised explosive devices.

The Mine De-Armer is a lightweight (3 kg), easily transportable system for use against lighter munitions. The use of de-armers and disruptors is a safe, economic way of rendering landmines and UXO of various kinds safe. All the equipment mentioned is cost-effective, especially in light of the limited budgets of many of the organizations involved in humanitarian clearance. Moreover, since the items are manufactured and exported directly from Cambodia, there are no delays associated with export license applications.

See endnotes page 67

Development Technology Workshop is a British-registered charity and an international nongovernmental organization (NGO) based in Cambodia that provides research, development, prototyping, and when required, manufacturing services to other NGOs and the local, private-sector industry. DTW is not a demining organization.

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